PLASTIC & RECONSTRUCTIVE SURGERY

VOLUME I

WARREN B. DAVIS, *Editor*

1946
THE WILLIAMS & WILKINS COMPANY
BALTIMORE, MARYLAND

Reprinted with the permission of the original publishers.
JOHNSON REPRINT CORPORATION
NEW YORK, NEW YORK

First reprinting, 1959, Johnson Reprint Corporation

CONTENTS OF VOLUME 1

NUMBER 1, JULY, 1946

NUMBER 2, SEPTEMBER, 1946

NUMBER 3, NOVEMBER, 1946

FOREWORD

Either as the primary objective or for repair after tissue destruction, "plastic" procedures are an essential part of every operation done by the general surgeon or specialist, with the exception of guillotine amputations, simple incisions, or tumor removal. Plastic surgery is essentially constructive, fosters refinements of technique and rests upon the common underlying principles of all surgery.

As a specialty, the field is individualistic both as to locale and extent but quality might be inverse to the spread of the latter. Surgeons established in other fields will on occasion refer a problem and upon such will the beginner get his start, for the results are literally outstanding and upon these can the laity base their jugements.

Plastic is one of the oldest surgical specialties.[1] The Edwin Smith Papyrum, copied in 1600 B.C., cites treatment of nose, ear, lip and chin injuries found in writings of 3000 to 2300 B.C.. but the Hindoos, 800 B.C., were the earliest to employ real plastic procedures. They were skilled in skin-shifting and other phases of reconstructive work. Celsus, called the father of the modern art, in 30 A.D. wrote a book which is remarkable for its accuracy of details.

Tagliacozzi, in 1597, published a treatise on his preparation and use of delayed arm flaps to the nose which was based on the work of Branca and son in Sicily about 155 years previously. Tagliacozzi's book contained 298 pages and 22 illustrations. The Indian rhinoplasty by means of a forehead flap, first described in England in 1794, was successfully used by Carpue in 1814. In the nineteenth century even before the advent of general anesthesia and later further stimulated by Pasteur's discoveries, plastic surgery made its greatest strides.

Throughout recorded history, plastic surgery has had its recurrent ups and downs. War has always been an incentive to the practice, even in the time of the Greeks. Its greatest submergence followed the control of sepsis and the widening field of abdominal surgery. World War I, with trench warfare, gave vast opportunities for facial repairs to the French and German surgeons. When the American forces went in, trench warfare was eliminated and the field was more generalized. One observation was that early treatment given in the front-line hospitals could change the ultimately required period for restoration from weeks to months, or maybe years. The majority of the cases evacuated to America for reconstruction had been wounded before special teams for this work had been distributed in forward hospitals.

In World War II, the group chosen by the Surgeon General and headed by Col. James Barrett Brown, had the special advantage of early air evacuation to England or America over distances up to 8000 miles. Brown's flair for teaching and for organization made the record of the group unique in both the quality and quantity of work and speed of accomplishment.

[1] The historical data are taken largely from the Address of the President, Dr. John Staige Davis, before the Southern Surgical Association in 1940, which is the record of a remarkably painstaking research well worth perusing.

The publications of Celsus and Tagliacozzi are outstanding. Later in increasing amounts, especially in the nineteenth and twentieth centuries, treatises on the subject are to be found in surgical literature but journals limited to this special phase are still rarities, and we know of none extant in this country. However, if of sufficient breadth and conciseness, there is no reason why this journal cannot have a broad field of usefulness to both "plastic surgeons" and men with plastic problems in other branches of surgical practice.

VILRAY P. BLAIR

THE DEVELOPMENT OF PLASTIC SURGERY IN THE UNITED STATES[1]

GUSTAVE AUFRICHT, M.D.

New York, New York

It is not unusual for some years to pass before the significance of the scientific advance in a particular field of medicine is fully recognized. In meeting the demands arising from World War II the growth in plastic surgery became clearly evident. Plastic surgery is a well-defined, undisputed branch of surgery, which carries a great share of responsibility for rehabilitating the wounded among our fighting forces, which assists in the repair of those injured in civilian life, and which constantly serves every class of our population in the reconstruction of the deformed.

In this decade of rapid progress in plastic surgery, particularly in its technical phases, we find it of interest to look back upon the pioneer period of plastic surgery in the United States. It should prove encouraging and stimulating to know this background and to take stock of the present status of our specialty in America.

While plastic surgery has a background extending thousands of years in medical history, as practiced in Egypt and India, it has emerged from oblivion but twice in the steady stride of the development of surgery in Western Civilization. It was introduced to the Occident in the fifteenth and sixteenth centuries by the Italian Branca family and Tagliacozzi, only to disappear from surgical interest for about two hundred years. Early in the nineteenth century in Europe, such surgeons as Carpue, Graefe, Lisfranc, Dieffenbach and others began their experiments with facial reconstruction by transplantation of tissues. In an era of scientific misgiving by the leading surgeons of the time, were laid the foundations of modern plastic surgery. It is heartening to know that American surgeons lost no time in searching, experimenting, and investigating the possibilities of this new field. Several of them journeyed abroad to study with these prominent European exponents of plastic surgery.

THE EARLY AMERICAN PIONEERS

It has been an interesting experience to look over the records of the early surgical pioneers in America. As in every field of human endeavor, certain figures are outstanding because of some original contribution in thought or practice. In order to show the clearly formulated attitude of these pioneers toward the problems of plastic surgery, it is illuminating to quote from their published works as freely as the scope of this brief historical sketch permits.

The earliest American surgeon on record who made major contributions to the field of plastic surgery was *John Peter Mettauer* (1787–1875). His father, Francis Joseph, also a surgeon, came to this country with Lafayette and settled in

[1] Revision of Paper read before the Thirteenth Annual Meeting of The American Society Plastic and Reconstructive Surgery, New Orleans, Louisiana, October 16, 1944.

Virginia, where John Peter was born. After being graduated from the University of Pennsylvania in 1809, he returned to Virginia, where he practiced general medicine and surgery. So great was his skill in the latter that he was soon able to devote himself almost entirely to it. He is credited with performing the first operation for cleft palate in the Western Hemisphere in 1827, using instruments designed by himself.

JOHN PETER METTAUER (1787–1875)

In his work called "The Story of Plastic Surgery," John Staige Davis says, "His (Mettauer's) article on staphylorrhaphy, in 1838, was one of the best up to that time, and his success in this type of work was well known. He described an operation for epispadias and hypospadias and was interested in many other plastic problems. He was a remarkable surgeon and far ahead of his time; he devised and made many new surgical instruments; he used wire sutures in curing vesico-vaginal fistulae twelve years before Simms reported the same method."

Regarding his personality, Davis continues: "Mettauer was quite eccentric and always wore an enormous stovepipe hat, which he seldom took off. He left

directions that he was to be buried in it, and it took an eight-foot coffin to contain the body and hat, together with some other things he directed to be buried with him." He lived to be 88 years old, an active surgeon to the very end.

A contemporary of Mettauer's, *Jonathan Mason Warren* (1811–1867), came of a family of surgeons for three generations, all of them holding professorships at Harvard University. After graduation in 1832, he studied abroad with Dupuytren, Roux, and others in London, Edinburgh, and Paris.

JONATHAN MASON WARREN (1811–1867)

Tinker states in his "America's Contributions to Surgery," published in 1902: "He (Warren) was the first to do the plastic operation on the hard palate now known as uranoplasty, in 1843, and had a record of twenty-four cases of this kind with only one failure, an unusually brilliant record even at the present day. He performed staphylorrhaphy for the defect of the soft palate one year after Roux of Paris, but quite independently, and is said to have operated in over one hundred cases of this kind, most of them very successfully."

In his book entitled "Surgical Observations with Cases and Operations,"

which was published in 1867, Warren devotes the second and third chapters to repair of the face and neck, reporting in detail eighteen cases of reconstruction for nasal defects. In addition, he gives interesting accounts of eyelid plastics and burns of the lip and neck. He advocated reconstruction of harelip a few hours after birth, as did his grandfather, John Warren.

As early as September, 1835, he performed an operation for the reconstruction of a nose, using the skin of the forehead according to the Indian method. He described the operation as follows: "The head was firmly supported by two assistants. During the whole of this long and painful operation the patient kept up his courage, and not a cry was uttered nor the least struggle made that could at all impede the motions of the operator. Not much blood was lost, and his strength was so little exhausted that he was able to run upstairs to his chamber."

He reports another interesting case (which merits mention because of the light it throws upon the charlatanism with which surgeons of that time had to contend). A young woman, twenty-seven years of age, from Maine, consulted him in 1839, having lost her nose. Warren gives the following case history: "Sixteen months before, having a wart on her nose, she was induced by her friends to apply for advice to one of those quacks styled 'cancer doctors,' who easily persuaded her that the affection was of a cancerous nature. A caustic was used which produced so great a degree of inflammation as to alarm her, and oblige her again to have recourse to him. His answer was that the application should be continued not only to the wart itself, but over the adjacent parts, 'so that none of the roots of the disease might escape.' It was therefore perservered in, and so effectually that at the end of a fortnight, all the flesh of the nose sloughed off, leaving her in a most deplorable condition. On reapplication to the quack as to what was to be done under the circumstances, he assured her that it was a most happy termination of the disease, which by these means, had been wholly eradicated; and that the nose, in the course of time, would grow out again and be perfectly restored." The nose was reconstructed by Warren.

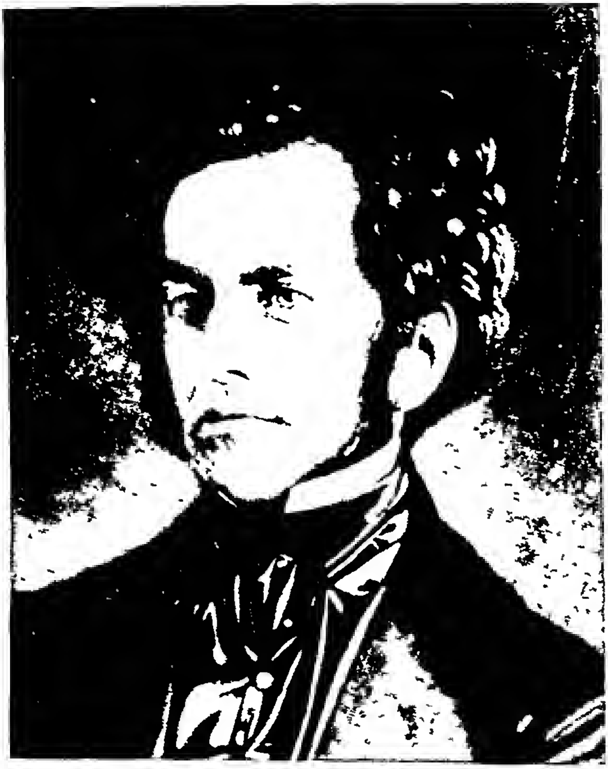
Although his book does not mention any free skin grafting, it is interesting to note that Pancoast, in 1844, credits Warren with "filling small breeches of surface with integument entirely detached from the arm or thigh and at once applied on the surfaec of the defect."

A short but meteoric career was that of another pioneer, *Thomas Dent Mütter* (1811–1857), a native of Virginia. He was graduated from the University of Pennsylvania in 1831, going to Europe shortly thereafter to study with Dupuytren, Boyer, Roux, Lisfranc, Velpeau, and Larrey.

Joseph Pancoast, his friend and colleague at the Jefferson Medical College, delivered a commemorative lecture on him in 1859, in which he said in part: "He (Mütter) had witnessed, while abroad, the opening of new fields of surgery in which, perhaps, the greatest of the modern achievements of the art have been accomplished. He had seen the great domain of plastic surgery revived from its golden relics, and its principles applied by the surgeons of Paris, and by Dieffenbach and Liston.

"Adopting with all the enthusiasm of his nature the new precepts which he had been taught for the relief of these affections, he settled down among us."

Mütter made an exhaustive study of scar formation and the characteristics of scars. He described an operation performed in 1841 on a twenty-eight year old woman who had been badly burned twenty-three years earlier, having the usual "drawing down of her chin to within one and one-half inches from the top of the sternum, which made her unable to close her mouth, nor could she turn her head from side to side."



THOMAS DENT MÜTTER (1811–1857)

To continue in Mütter's words: "The patient being placed in a strong light, and seated on a low chair, her head was thrown back as far as possible and sustained in this position by an assistant.

"Seating myself in front, I began the operation by making an incision which commenced on the outside of the cicatrix in sound skin, and passed across the throat into sound skin on the opposite side." After very extensive dissection of the scar, and the division of the sterno-cleido mastoid muscles of both sides, he proceeded with the formation of a large flap from the shoulder, which he utilized to cover the defect. He described it as follows:

"The next step in the operation consisted in the detachment of a flap of sound skin, with which this chasm could be filled; for I knew very well that if permitted to heal by granulation only, the patient, so far from being benefited, would be made worse than before. To obtain this flap, I commenced at the terminal

Burn scar contracture of neck corrected with skin flap from shoulder region, original drawing from Mutter's article

extremity of the first incision, and carrying the scalpel downwards and outwards over the deltoid muscle, dissected up an oval piece of integument, six and one-half inches in length by six inches in width, leaving it attached at the upper part of the neck. This dissection was painful but not bloody, only one small vessel being opened. The flap thus detached was next brought around by making a half turn

in its pedicle, placed in the gap it was destined to fill, and carefully attached by several twisted sutures, but no other dressing was deemed advisable. The edges of the wound on the shoulder from which the flap had been removed, were next brought together by straps and sutures, and, with the exception of its upper third, was completely covered in. A pledget of lint moistened with warm water was laid upon this raw surface, a bandage applied by which the head was carried backwards and maintained in this position, and the patient put to bed.

"In very extensive cicatrices of the neck it may be well to modify the operation so as to take a flap from each side, by which means we shall avoid the risk of a very large single flap."

He claims priority for this operation saying: "Many shocking deformities from burns have been relieved by the performance of operations conducted on these principles; for example, the eyelid, the cheek, the nose, and the lip have all been restored; but I believe I may claim the merit (if merit there be in adapting an old principle to a new operation) of having first performed an operation of the kind for the relief of extensive cicatrices of the throat."

From the ameliorating perspective of time, it is perhaps permissible to inject a little of the gossip of his contemporaries about this colorful and brilliant surgeon. Gross notes that some of his colleagues, while speaking with enthusiasm of his ability as a lecturer and surgeon, thought that "he practiced various artifices to enhance his reputation and increase his practice."

Pancoast gives this intimate picture of the man Mütter: "Youthful looking, neat and elegant in his attire, animated, cheerful and distinguished in his bearing, whether observed in the social circle or encountered as, with his tall gray horse and handsome low carriage, he traversed our fashionable thoroughfares."

Another outstanding surgeon imbued with deep interest in plastic surgery was *Joseph Pancoast* (1805–1888). He was graduated from the University of Pennsylvania in 1828, and became professor of surgery at Jefferson Medical College in 1838. In 1844 he published an exhaustive book entitled "A Treatise on Operative Surgery," which was superbly and profusely illustrated. He described several original operations, among them the closure of a perforation of the hard palate, an operation for the reconstruction of nasal defects by use of the skin of the cheek, and one for the reconstruction of the upper lip by rotating flaps from the adjacent regions of both cheeks.

Pancoast made use of skin flaps tubed in reverse direction, wound side out, terming the procedure "rolling of the flaps." To quote him: "An elongated rectangular portion of integument is to be cut up and rolled upon its cutaneous surface."

He recognized the inherently individual character of plastic surgical procedures, stating: "The deformities requiring operations of this class are necessarily so dissimilar in different cases that every new one becomes a separate subject of study to the surgeon and opens a fresh field for the exercise of his ingenuity in restoring the lost or deformed parts."

About free skin grafting he makes the following revealing statement: "*In several instances a portion of integument has been entirely detached from the arm or*

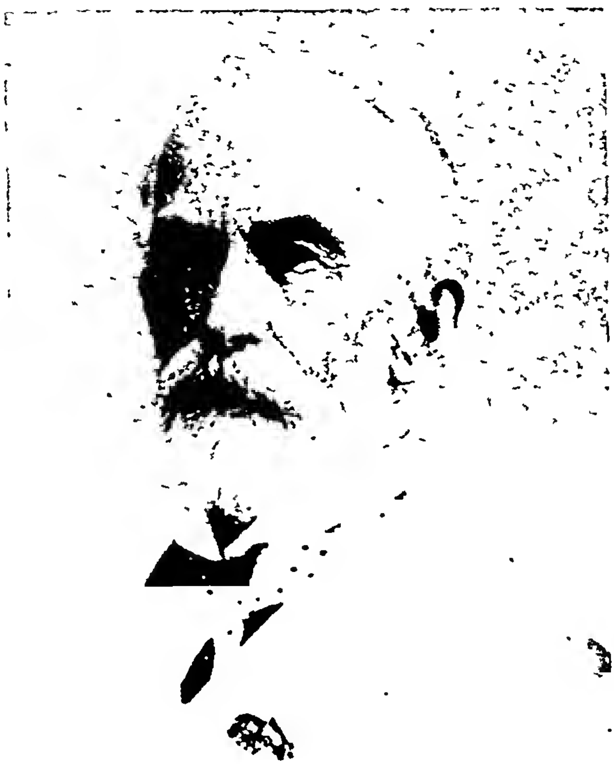
thigh and at once applied on the surface of the defective organ, the edges of the latter having been previously freshened with the knife. By this means small breaches of surface have been filled up by Dr. J. M. Warren of Boston, and others, though it generally failed in the practice of Graefe and Bunger, who made frequent trials of it. This practice is founded upon the fact that parts completely severed by accident from the body have, after many minutes or even a half an hour have elapsed and they have become perfectly pale and bloodless, occasionally been

JOSEPH PANCOAST (1805–1882)

found still to retain a sufficient degree of vitality to accept union after nice adjustment to the organ whence they had been removed. It has been successful in the hands of the author (Pancoast) where the lobe of the left ear had been torn completely off."

This statement on free skin grafting made in 1844 is most interesting in its medico-historical aspect as it antedates by about thirty years the epochal works of Reverdin in 1869, Ollier in 1872, and Thiersch in 1874.

At this juncture should be mentioned the name of *Frank H. Hamilton* (1813–1881), a prominent surgeon of Buffalo, who was erroneously credited with performing the first free skin grafting operation It was even referred to as the "Hamilton-Reverdin graft." However, from his treatise "Elkoplasty, or Anaplasty Applied to the Treatment of Old Ulcers," published in 1854, we learn what he really did Namely, he transferred a pedicle flap from one leg to the other to cover a chronic ulcer. The success of this procedure at a time when it was



FRANK H HAMILTON (1813–1886)

considered that "an ulcer in 1830 will be an ulcer in 1860," evoked an enthusiasm that partly explains the error in crediting him with free skin grafting Furthermore, his observation that from the skin flap, which was somewhat smaller than the ulcer, epithelium grew over the granulation to meet the healthy periphery, contributed to the error It is interesting to note, however, another achievement in connection with this operation. Two weeks previous to the transplantation he raised the flap and left it in its original position to insure blood supply, thus

advocating the delaying operation, the importance of which is generally recognized today. He describes the procedure as follows:

"Lint, spread on both surfaces with simple cerate, was laid between the flap and the surface from which it had been detached, other pledgets of lint similarly covered were placed on the outer surface, while over all and around the entire limb was wrapt a large mass of cotton batting, secured in place by a lightly turned roller."

Two weeks later "The flap was made raw again on its margins, and its lower surface shaved off, with the double purpose of removing the granulations and of diminishing its excessive thickness." He had previously removed the granulation and part of the cicatrix from the ulcer, forming a deep bed. "The left leg was carried across the right. . . . The flap was now brought snugly into its new bed, on the right leg, and well secured with interrupted sutures, a moderate compress, and roller. The two limbs were further secured immovably to each other by bands."

During the Civil War Gurdon Buck and David Prince were two of the ablest representatives of plastic surgery. *Gurdon Buck* (1807–1877), a graduate of the College of Physicians and Surgeons in 1830, spent about three years in Paris, Berlin, and Vienna. Returning to New York, he shortly became a leading surgeon, working at St. Luke's, the Presbyterian, and the New York Hospitals. Weir, his pupil and colleague, describes him as a "large man, slow in action and in speech, but having a thoughtful mind and fertile in surgical expedients."

He published a manual on plastic surgery in 1876 entitled "Contributions to Reparative Surgery in Its Application to the Treatment of Deformities Produced by Destructive Disease or Injury; Congenital Defects from Arrest or Excess Development; and Cicatricial Contracture from Burns." His warm interest in the disfigured is expressed in the following: "While these cases have a very strong claim upon our commiserations, they should stimulate us as surgeons to our greatest efforts for their relief, as they so often in the past have been dismissed as hopelessly incurable.

"There is no department of surgery where the ingenuity and skill of the surgeon are more severely taxed than when required to repair the damage sustained by the loss of parts, or to remove the disfigurements produced by destructive disease or violence, or to remedy the deformities of congenital malformation. The results obtained in such cases within the last half century are among the most satisfactory achievements of modern surgery."

Weir, in his "Personal Reminiscences of the New York Hospital," states: "Twice during the Civil War did the New York Hospital appear on the scene in the person of Dr. Buck, who, sent by the Sanitary Commission, came to us after the Antietam and Monocacy battles and gave great help by his operations and advice. It was on one of these visits that Dr. Buck became much interested in a disabled soldier who had been treated at his regimental camp for an attack of pneumonia followed by a rapid gangrene of his mouth that progressed so fiercely that when he arrived at the General Hospital we found he had lost the whole left cheek, the left side of the nose, and most of the upper left jawbone. This

horrible deformity appealed to the Surgeon General who saw the case, and also to Dr. Buck, who had had a large experience in plastic surgery and in the remedying of severe facial defects. By a series of operations during the course of several months, Dr. Buck was able, by sliding skin from the neck, temple, and lips, together with dental aid, to replace the lost upper jawbone, to fill up the huge gap with new flesh and restore the patient, though much necessarily scarred, to an effective condition and not too offensive to a neighbor's

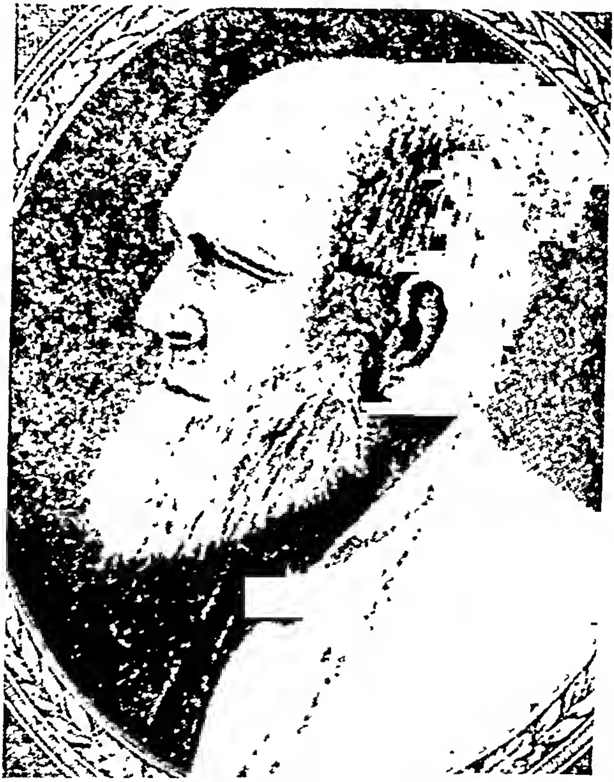
GURDON BUCK (1807–1877)

eye." Several other cases of reconstruction of the war wounded are described by Buck.

There is no mention of free grafting in any of his writings. Secondary defects on the forehead after rhinoplastic reconstruction were left to heal by granulation. He stresses, however, the formation of fine scars as a necessity, advocating closely placed oblique skin sutures, the sutures to include more tissue in depth rather than surface, as these, when tied, evert the skin edges. He removed the alternate

sutures after twenty-four hours. He also describes an original operation for the reconstruction of defects of the lip by transplantation of tissues.

David Prince (1816–1889), a graduate of the Medical College of Ohio, settled in Jacksonville, Illinois. He served as a brigade surgeon during the Civil War. It is related of him that when a large number of the men from his brigade were taken prisoner, he voluntarily surrendered and accompanied them to Libby Prison so that he might look after their welfare.



DAVID PRINCE (1816–1889)

He published "Plastics and Orthopedics: Three Reports to the Illinois State Medical Society in the Years, Respectively, 1864, 1867, and 1871." This book is a valuable, detailed and critical survey of the various methods in plastic surgery then practiced.

In his introduction, Prince gives this excellent and permanently true admonition to specialists: "There is a misconception cherished in the medical profession that the practice of it is like the business of a shoemaker's shop, in which each

ing sheets of detached portions of epithelium and transplanting these to the surface of ulcers not inclined to heal."

He took "bits of skin about half the size of canary seeds" with the aid of a cambric needle and knife. Although observing good take and healing by this method, he preferred the method of grafting larger sheets, about which he remarks that it is "peculiar and not before practiced, so far as I am aware." The idea apparently came to him in the following way. He passed the bed of a patient suffering with ulcer over his ankle shortly after the patient had soaked his feet, and noticed a loosely hanging sheet of epithelium above the ulcer. He cut several patches of this, of varying sizes, measuring one inch to half an inch in diameter, and applied them to the ulcer. "With the patches," Hodgen says, "I completely cured the ulcers." Later a chill developed, and much of the skin was lost.

Small skin grafts. "Portions of true skin with epithelial layer." Original drawing from Hodgen's article

He repeated the same method in another case, the history of which he gave as follows: "On the 11th of March, 1871, a patient had his hand crushed off near the base of the metacarpal bone, removing the entire hand except the thumb and the base of the metacarpal bones of the four remaining fingers and the carpus, thus leaving a large surface to heal by granulation. On the 15th of May there remained a surface measuring one and one-half by two and one-half inches unhealed. To this surface I applied sheets of dry epithelium from the neighboring parts of the same wrist, and on the 23rd of May it was almost entirely healed." Unfortunately, Hodgen does not mention the means by which he took the sheets of skin from the donor area in this case.

He also described scraping the dry epthelial scales from the side of a foot and applying them to an ulcer, reporting a successful outcome. He took portions of moles and used these as grafts, as well as parts of skin stained with India ink.

A review of the chronology of events in free skin grafting reveals interesting facts. Reverdin reported his procedure of grafting small islands of epithelium before the Societé Imperiale in Paris on December 8, 1869. Hodgen used bits of skin grafts early in December, 1870, almost a year to the day from the time of Reverdin's report. On the other hand, although somewhat vaguely and without specific technical detail, Hodgen mentions in his article published in July, 1871, two cases in which he transplanted "sheets of epithelium," while Ollier did not make his report on large skin grafting until 1872, and Thiersch in 1874.

CORRECTIVE RHINOPLASTY

Rhinoplastic operations throughout history have been more or less the axis around which plastic surgery has developed. The nose being such an exposed and characteristic feature of the face, its defects and deformities are most conspicuous In the very early history of plastic surgery, the reconstruction of nasal defects predominated. With the improvement in surgical technic and safety in operative procedure, attempts were made to carry out rhinoplastic corrections not only for defects but for congenital deformities.

The first person known to have executed this type of operation through the endonasal route without injuring the skin was *John Orlando Roe* (1848–1915) of Rochester, New York. In his paper, "The Deformity Termed 'Pug Nose' and Its Correction by a Simple Operation," published in June, 1887, he describes an operation on the tip of the nose to reduce its prominent bulbous formation, dealing both with the fleshy hypertrophy and the cartilaginous deformity. The operation was performed by the endonasal route. He admonishes that "great care must be exercised not to cut through into the skin, lest we have afterward a scar or dent in the external surface of the nose."

An interesting and somewhat embarrassing incident happened when Jacques Joseph of Berlin, recognized as the foremost author of the principles and more or less classic methods of endonasal rhinoplastic operations, first presented his endonasal approach in Berlin in 1898. A physician from San Francisco present at the meeting afterwards told Joseph that two American surgeons, Roe in 1887 and Weir in 1892, had used the endonasal approach previous to him. Unquestionably Joseph, who was a genius himself in this field, devised the method independently, making the report without knowing of the previous work of others.

Roe devised an interesting operation for the reconstruction of the columella by folding a mucous membrane flap from the inner side of the upper lip, and pushing it out through the lip at the base of the proposed columella.

His exceptional esthetic sense is shown in the following statement: "In the correction of all facial defects the surgeon must be not only an artist but also more or less of a sculptor, with perception of symmetry as related to the different features. How often do we see persons who in infancy had been operated on for harelip and fissured jaw, according to the principles most accurately laid down in surgical works, and who nevertheless present a most disfigured appearance, because of the entire disregard of the principles of proportion or symmetry."

Roe's appreciation also of the psychological aspect of plastic surgery is strikingly expressed. He says: "We are able to relieve patients of a condition which

would remain a lifelong mark of disfigurement, constantly observed, forming a never-ceasing source of embarrassment and mental distress to themselves, amounting, in many cases, to a positive torture, as well as often causing them to be objects of greater or less aversion to others.

- "It will be a surprise to any physician, who will take the trouble to investigate the subject, to find how many briliant lives, how many noble personalities, and how much valuable talent have been, so to speak, buried from human eyes, lost

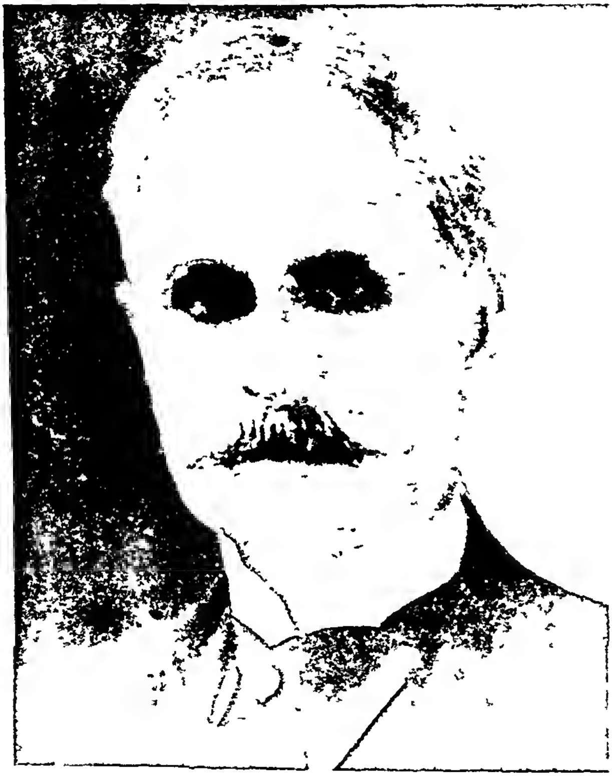
JOHN O. ROE (1847–1915)

to the world and Society, by reason of the embarrassment and mortification caused by the conscious or, in some cases, the unconscious influence of some physical infirmity or deformity or unsightly blemish.

"The effect upon the mind of such physical defects is readily seen reflected in the face, which invariably conforms to the mental attitude, and leads after a time to a permanent distortion of the countenance."

Robert F. Weir (1838–1927), a contemporary of Roe's, was graduated from the

College of Physicians and Surgeons in 1859. He had the unique experience of working as Dr. Gurdon Buck's assistant for three years before his formal medical training. After serving in the Civil War he returned to New York where he practiced surgery. He made important contributions to the development of rhinoplastic surgery, a well-known one being his crescent-shaped excision from the base of the ala nasi



ROBERT F. WEIR (1838–1927)

George Howard Monks of Boston (1853–1933), being graduated from Harvard in 1875, spent the next year in the Department of Architecture at the Massachusetts Institute of Technology before returning to Harvard for his medical education.

In his "Correction by Operation of Some Nasal Deformities and Disfigurements," 1898, he says: "After considerable experience I have become convinced, as probably most of you have, that few patients suffer more of mental discomfort than the unfortunate possessors of some unsightly disfigurement on the face which attracts constant notice Few are more solicitous for any operation

which promises relief, and none are more grateful for the slightest improvement in their condition."

Among other operations he describes one for rhinophyma, or as he calls it, "hypertrophic acne." His operation consists of the excision of the hypertrophic tissues, leaving only thin skin flaps, which are eventually used to cover the denuded nose. A colleague to whom he described this operation tried to perform it, but his flaps sloughed away by accident. However, the denuded nose ulti-

GEORGE HOWARD MONKS (1853–1933)
Professor of Oral Surgery

mately healed by scar epithelium and was even so, a great improvement over the original condition.

On the basis of this accident, Roe drew the conclusion that rhinophyma could be corrected by merely shaving off the hypertrophic nodules at their base and leaving them to heal by scar epithelium. Monks remarks that he will try this method of shaving off the growth but instead of letting it heal by itself he may place a few thin skin grafts over it. Thus in this one article he describes three

new surgical methods for the treatment of rhinophyma, which are the same methods that are being used today.

In October of that same year (1898) Monks reported on the reconstruction of a new eyelid with a flap from the temporal region on "a long pedicle of subcutaneous tissue containing the artery." He made a tunnel between the proximal end of the pedicle and the eyelid defect through which the flap was pulled, burying the pedicle in the tunnel.

PLASTIC SURGERY AS A SPECIALTY

In presenting these outstanding pioneers of the nineteenth century I have tried to point out only those who, over and above their high level of performance as surgeons, brought about the new specialty of plastic surgery. There have been many who, in the course of their work in general surgery, have made contributions to plastic surgery as a whole. But of necessity, I had to confine myself to men who were engaged in, and identified themselves with, plastic surgery to a conspicuous extent.

It is not intended, within this brief sketch, to name or evaluate the excellent roster of numerous contemporary American exponents of plastic surgery. Instead, from now on an endeavor will be made to show the interesting crystallization and dynamic growth of plastic surgery as it takes its rightful place among the other recognized surgical specialties.

A few of the nineteenth century pioneers continued their work into our present century. In spite of the early foundation established by these outstanding surgeons, however, plastic surgery as a recognized specialty could not escape the growing pains of adolescence. Realizing the eagerness of the public to resort to surgery for the correction of deformities, irresponsible and poorly trained members of the profession explcited the situation. For a while plastic surgery struggled at the abyss of disrepute caused by the commercializing charlatans. In order to dissociate themselves from this mercenary group, ethical representatives gave different names to the specialty, such as "reconstructive surgery," "reparative surgery," "facio-maxillary surgery," etc. Their position within the profession was not the easiest, as the importance of elective surgery was questioned and their work shifted from department to department in general hospitals.

Not until the First World War did the important role of plastic surgery become recognized. In June, 1917, there was organized the section on Head Surgery, with Dr. Vilray P. Blair as Chief of Plastic Surgery. In February, 1918, a group of fifteen surgeons and fifteen dentists who had done some work in this line, went overseas to work in teams under the supervision of the Chief of Plastic Surgery. In this country, three hospitals were especially designated for plastic surgery cases, namely Jefferson Barracks in Missouri under Dr. Blair, Walter Reed under Dr. Robert Ivy, and Ft. McHenry under the late Dr. George Schaeffer.

Even after the First World War, however, the place of plastic surgery as a surgical specialty was not well defined, and its place on hospital services was questioned. This is partially explained by the fact that the specialty itself was not

fully clarified, and its boundaries and those of the related fields were still undefined. While there were a few hospitals which conducted clinics for the general public, they functioned as a partial activity of either the surgical, orthopedic, or some other department. Only a few surgeons could afford to declare their full interest in this precarious specialty.

In 1919, *John Staige Davis* published his important book "Plastic Surgery." It is one of the first modern, fundamental, comprehensive, informative books on the specialty and will have a permanent value for the student of plastic surgery.

Gradually in the late 1920s, due to the increasing recognition and appreciation of the importance of the surgical correction of deformities, more and more hospitals established plastic surgery services. In 1930 the City of New York introduced plastic surgery clinics for the poor in five of its city hospitals. From that time, hospital after hospital followed the example until today there are twenty-two plastic surgery services in greater New York. It is difficult accurately to ascertain the number of services existing throughout the country, especially due to the temporary closing of some on account of the exigencies of war, but they are unquestionably numerous and well distributed. Where no organized plastic surgery service exists, authentic specialists practice their specialty within other departments.

THE GROWTH OF LITERATURE ON PLASTIC SURGERY

A survey of the medical literature since 1910 reveals an interesting increase in the number of publications on subjects related to plastic surgery. Accurate count of these was not possible due to the variety of subdivisions and titles under which they appear. About 26 articles were published in 1910. After a rise during each year of the first World War, the number dropped to around 24 in 1920. Both in 1930 and in 1940 there were roughly over a hundred publications. Since the catastrophe at Pearl Harbor articles related to this subject have increased practically in geometric progression. Simultaneously, numerous manuals on the various branches of the specialty have appeared.

ORGANIZED DEVELOPMENT OF PLASTIC SURGERY

The first national organization including representative plastic surgeons was organized in 1921 as the American Association of Oral Surgeons. By 1927 the name had been changed to The American Association of Oral and Plastic Surgeons. In 1942 it became The American Association of Plastic Surgeons, with a membership of 77.

Our Society was organized under the name of The Society of Plastic and Reconstructive Surgery in 1931. As its steadily increasing membership included representatives throughout the country, the name was changed to The American Society of Plastic and Reconstructive Surgery in 1941. Today it has an active membership of 100 besides Honorary and Corresponding members.

The most significant step toward recognition of the specialty was made when the American Board of Plastic Surgery was formed in June, 1937. It was a tentative organization until May, 1938, when it was recognized as a subsidiary of the

American Board of Surgery. The final step in the development of plastic surgery as a specialty was when, in May, 1941, the Advisory Board for Medical Specialties of the American Medical Association gave the Board of Plastic Surgery the status of a major Board. This long, laborious road to full recognition was achieved largely through the efforts of Dr. Vilray P. Blair.

"The American Board of Plastic Surgery grants and issues certificates of recognition of special knowledge in plastic surgery to surgeons meeting the requirements." One of the Board's great achievements is the standardization of the training of plastic surgeons on a level with the other surgical specialties. It demands as a basic requirement two years of graduate study in general surgery before special training for another two years, recognizing the great responsibility of the plastic surgeon in dealing with the reconstruction problems of the entire body. While it is within the discretion of other specialists to perform plastic operations on their respective anatomical fields, a plastic surgeon must be fully equipped to work on the face as well as on the entire human body.

The Board recognized as founder members those who had adequately proved their authority in the field of plastic surgery through years of experience and of maintaining high standards in their professional conduct. There are at present a total number of 168 Diplomates, many of whom were in the Armed Forces.

There are an increasing number of training facilities in residencies in plastic surgery services on the files of the American Board of Plastic Surgery. If to these, the opportunities available at the plastic surgery centers of the Army and Navy are added, one can assume without exaggeration that there are training facilities for at least forty to fifty young surgeons under authoritative leadership. This means that yearly this number of well-trained plastic surgeons may be expected to join the field. While this is already a substantial number for such a highly specialized field, it will undoubtedly increase in the future. Both the profession and the public may look upon this advance with confidence and be assured that there is no place for inadequate fly-by-night courses in plastic surgery which would profess to turn out plastic surgeons or part-plastic surgeons in a few months.

Plastic surgery has had its influence upon other fields. General surgery is making wide use of one of its most important developments, i.e., skin grafting for burns and extensive skin defects due to different causes. Especially since Padgett's ingenious invention of the Dermatome has skin grafting become a widely practiced therapeutic measure. In orthopedic surgery, skin transplantation is of great value in conjunction with some operations on the extremities. The possibility of reconstruction of extensive defects has enabled and encouraged more and more radical extirpation in cancer surgery. In blepharoplastic, rhinoplastic, and otoplastic operations, plastic surgery has often helped to solve pathological and physiological problems. Finally, plastic surgery has influenced even medicine and psychiatry by frequently solving severe underlying psychological disturbances due to deformities.

World War II did not find plastic surgery in the United States unprepared, as both qualitatively and quantitatively this branch of the profession has been

able to cope with the increased demands created by the war. The Army and Navy established plastic surgery centers where reconstructive cases were concentrated and treated by authentic plastic surgeons. Besides these centers, a number of accomplished plastic surgeons were connected with many other medical units and, with high efficiency, took care of the disfiguring casualties that came to them.

The importance of enlightened and adequate primary care of disfiguring wounds being recognized, training courses in plastic surgery under acknowledged specialists were provided for a number of army and navy surgeons and dentists. According to information received from the Surgeons General of the Army and Navy, about 500 took these courses. While these men could not in any way be considered as full-fledged plastic surgeons, they made a valuable contribution in aiding the wounded.

The dissemination of these service-trained men throughout the Medical Corps necessarily influenced the whole approach of early treatment. In this connection, it would not be amiss to quote Blair's experience in the First World War. "In the A.E.F. in World War I, early care of facial injuries was somewhat standardized and its importance emphasized by a small group of teams, surgeon and dentist, being assigned as regional consultants. All this helped to promote a coordinated sequential plan of treatment which can be considered as largely responsible for the somewhat curious fact that the majority of face injuries evacuated to the United States for treatment had occured before the battle of St. Mihiel, while from the later engagements, Argonne, etc., apparently rather few were sent home as casualties."

It is interesting to reflect upon the fact that only a relatively small proportion of the plastic surgeons available throughout the country, taking the 43 out of 168 Diplomates of the American Board as a norm characteristic of the whole, met the needs of the Armed Forces for plastic repair. This is encouraging from the point of view that with the end of the War when the wider need for final, prolonged reconstructive work presented itself, there was available, in addition, a large number of experienced, accomplished plastic surgeons.

This review has made evident that American pioneers have contributed an important share in the development of plastic surgery, and that both organized and individual representatives of the specialty have reached a high standard in this country.

REFERENCES

DAVIS, JOHN STAIGE: The story of plastic surgery. Ann. Surg., **113**: 641–656 (May) 1941.

TINKER, MARTIN B.: America's contributions to surgery. Bull. Johns Hopkins Hosp., **13**: 209–213 (Aug.–Sept.) 1902.

WARREN, JONATHAN MASON: Surgical Observations with Cases and Operations. Tichnor and Fields, 1867.

WARREN, JONATHAN MASON: Rhinoplastic operation. Boston M. & S. J., **16**: 69–79, 1837.

PANCOAST, JOSEPH: A Treatise on Operative Su[illegible] f Various Processes of the Art Including All the New [illegible] Surgical Science in Its Present Advanced Conditi[illegible] ing Four Hundred and Eighty-six Separate Illustrations. Philadelphia, Carey & Hart, for G. W. Loomis, 1844.

PANCOAST, JOSEPH: A Discourse Commemorative of the late Prof. T. D. Mütter, M.D., LL.D., being the Introductory Lecture to the Course of Anatomy in the Jefferson Medical College of Philadelphia, delivered Oct. 14, 1859.
MÜTTER, THOMAS DENT: Cases of Deformity from Burns by Plastic Surgery. Philadelphia, Merrihew & Thompson, 1843.
HAMILTON, FRANK H.: Elkoplasty or Anaplasty Applied to the Treatment of Old Ulcers. Holman, Gray & Co., 1854.
BUCK, GURDON: Contributions to Reparative Surgery in its Application to the Treatment of Deformities Produced by Destructive Disease or Injury; Congenital Defects for Arrest or Excess Development, and Cicatricial Contractures from Burns. D. Appleton & Co., 1876.
PRINCE, DAVID: Plastics and Orthopedics: Three Reports to the Illinois State Medical Society in the Years Respectively,, 1864, 1867, and 1871. Philadelphia, Lindsay & Blakiston, 1871.
WEIR, ROBERT F.: Personal reminiscences of the New York hospitals. General Bulletin, Soc. New York Hosp., 1: No. 10, 1917.
HODGEN, JOHN T.: Cell of skin grafting. St. Louis M. & S. J., 8: 289 (July 10) 1871.
WEIR, ROBERT F.: On restoring sunken noses without scarring the face. New York M. J., 56: 449–454 (Oct. 22) 1892.
ROE, JOHN ORLANDO: The deformity termed 'pug nose' and its correction by a simple operation. M. Rec., 31: 621–623 (June 4) 1887.
MONKS, GEORGE HOWARD: Correction by operation of some nasal deformities and disfigurements. Boston M. & S. J., 139: 262–267 (Sept.) 1898.
MONKS, GEORGE HOWARD: Reconstruction of a new eyelid with a flap from the temporal region. Boston M. & S. J., 139: 385–387 (Oct. 20) 1898.
BLAIR, VILRAY P.. Relation of the early care to the final outcome of major face wounds in war surgery. Mil. Surgeon, 92: 12–17 (Jan.) 1943.

PRESENT EVALUATION OF THE MERITS OF THE Z-PLASTIC OPERATION

JOHN STAIGE DAVIS, M.D.

Baltimore, Md.

I have been asked by Dr. Warren B. Davis, the Editor, to briefly evaluate for the first number of the new Journal, "Plastic and Reconstructive Surgery", the use of Z-plastic operations and to sum up in a general way my long personal experience with the method. The name Z-plastic is given to the procedure because the outline of the incision is roughly that of a Z or reversed Z. The maneuver is based on the transposition of two triangular flaps developed by the Z-incision, whose angles may be equal or unequal, and its success depends on the presence of lax tissue on each side of the contraction.

In a paper read before the American Surgical Association in 1931, Davis reported that the Z-incision with transposition of flaps was first used by Denonvilliers in 1856, for the relief of an ectropion of the outer third of a lower eyelid and that he developed the procedure in steps. In another paper by Davis with Kitlowski, published in 1939, a further study of Z-plastic methods was made, and the mathematical basis of shifting triangular flaps with the possibilities and limitations as worked out by A. A. Limberg of Leningrad was discussed.

In these two papers the literature and the entire subject was fully covered, and there has been nothing of importance added since that time. I have drawn freely from these papers in the preparation of this contribution. It is interesting to note that although the Z-incision with the transposition of flaps thus made was first reported about 90 years ago, the procedure has during this period been lost sight of, and rediscovered, and redescribed as new, by a number of surgeons. It is very improbable that this will ever happen again as the value of the method is now thoroughly established, and Z-plastics are described and illustrated in nearly all new books on plastic surgery, and also in those on general and orthopedic surgery.

In spite of the fact that the Z-incision with the transposition of flaps is used more and more frequently by surgeons dealing with contractures, as they become familiar with its advantages, there is still considerable confusion as to the actual theory and use of Z-shaped relaxation incisions and of the utilization of the triangular flaps thus formed to relieve contraction. Many surgeons do not understand the principles of the procedure at all. Although I have used the method for many years successfully and formed the angles, which were effective by experience, since Limberg's papers appeared, I have approached the method from a more definite mathematical viewpoint for purposes of accuracy, and in consequence find the procedure easier to explain and simpler to carry out, although my results have not been improved.

The ideal place for the use of the Z-incision with the transposition of the tri-

angular flaps thus formed, is in those instances where the skin is of normal texture, and where a web exists, such as may be found in congenital webbing of the neck or popliteal space; also in certain cases of partial syndactylism, and of congenital displacement of normal surface levels. There are sometimes congenital grooves around the fingers, wrists, arms, toes and legs where a constriction surrounds the affected part, and in these cases the Z-plastic procedure,

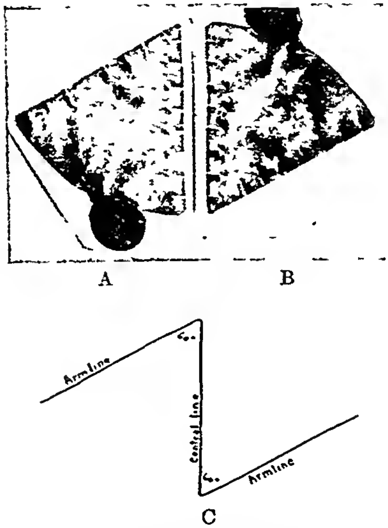


FIG. 1. ILLUSTRATING THE USE OF A SIMPLE GADGET IN LAYING DOWN THE INCISION LINES FOR THE ORDINARY Z-PLASTIC

The point of the "arrowhead" shaped piece of thin copper sheeting is a 60° angle, and the edges are marked out in centimeters

A. One edge is placed on the contracted scar band to form the central line of the proposed Z or reversed Z, and this line is marked out for the length desired. The arm line, of the same length, is laid down along the other edge of the "arrow", which has been maintained in its original position, and this line will be at a 60° angle with the central line.

B. The "arrowhead" is then reversed and its point is placed at the other end of the central line but on the opposite side, and the same edge along which the original central line was marked is again placed along the contracted scar band, but in a reversed position. The other arm line is then marked out, and the "arrowhead" is removed leaving a Z or reversed Z pattern with arm lines parallel at a 60° angle to the central line. All of these lines should be of equal length. The tag on the "arrowhead" is to facilitate handling during sterilization and to minimize the chance of loss in the instrument case.

C. The pattern of the Z marked out by using the "arrowhead" shaped piece of copper as described in A and B.

either single or in series, has been in my experience the most satisfactory method of treatment.

These congenital deformities however, are comparatively rare, and in the vast majority of instances where Z-plastics are used, the deformity is due to scar contracture following extensive burns or trauma, and the tissues dealt with are

composed either entirely of scar or of skin more or less infiltrated with scar. A knowledge of the utilization, in the final repair, of scar tissue and tissues more or

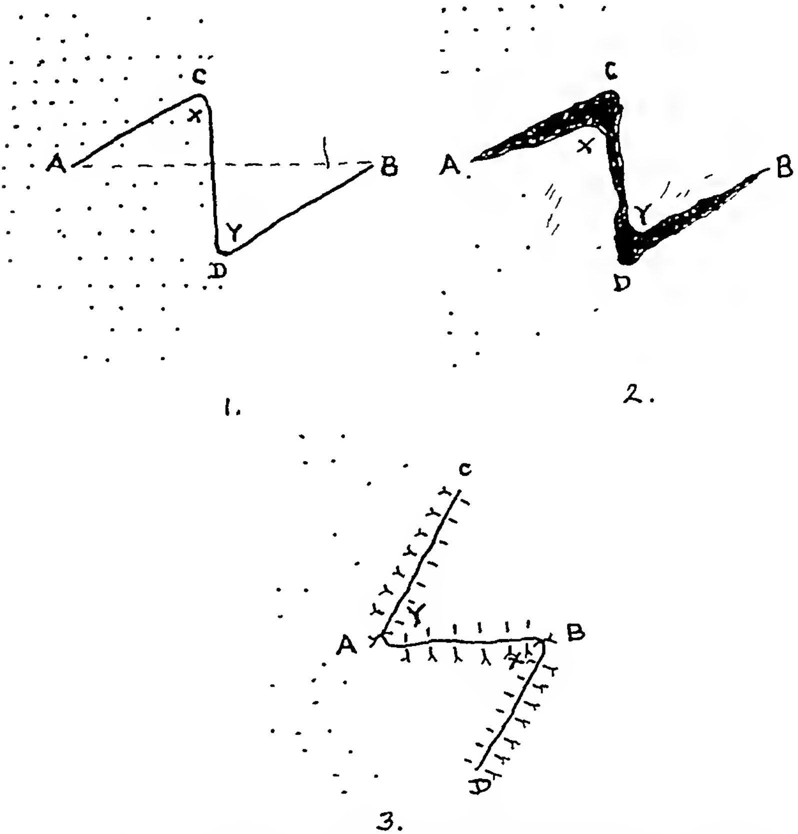


Fig 2 1 Schematic drawing of the Z incision The Z is drawn with the central and arm lines of equal length The arm lines are placed at an angle of 60° to the central line and are parallel to each other The central line CD is the short diagonal of the parallelogram and the broken line AB is the long diagonal The dotted half of the area is to show the transposition more clearly

2 The incisions have been made along the Z shaped pattern ACDB and the two triangular flaps X and Y are completely undercut to their bases

3 The flaps have been transposed The tip of the flap X being sutured to the point B and the tip of the flap Y to the point A, and the rest of the wound closed The closure is still in the shape of a Z but it is rotated about 90°, and the central line of the original Z now lies transversely across the line of scar pull It will be found that the distance between the points C and D has been lengthened by the difference between the lengths of the long diagonal AB and the short diagonal CD.

less infiltrated with scar is essential for the surgeon in the successful performance of Z-plastic operations.

1 2

FIG 3 BILATERAL CONGENITAL DEFORMITIES OF HANDS ILLUSTRATING THE USE OF THE Z INCISION WITH THE TRANSPOSITION OF FLAPS TO RELIEVE DEEP GROOVES ON MIDDLE AND RING FINGERS OF RIGHT HAND

1 Shows the deep grooves on ring and middle fingers of right hand, also various other malformations

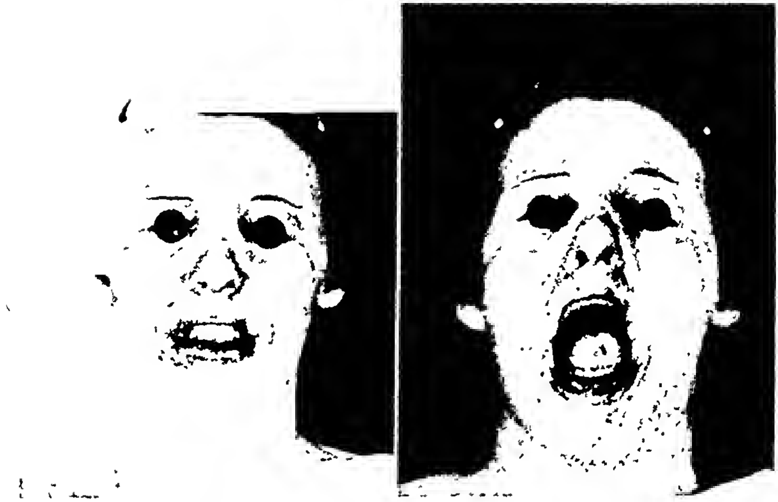
2 Result of Z plastics on these fingers Note the obliteration of the grooves

1 2

FIG 4 ILLUSTRATING THE USE OF Z INCISIONS IN RELAXING PUCKER STRING SCARS AROUND MOUTH

1 Burn scar of face 16 years duration The whole face is involved The scar is particularly thick around mouth There is some eversion of lower lip, and the angles of the mouth are shortened

2 When mouth is opened pucker string scars can be seen around mouth. The scars in the nasolabial folds are continuous with those on each side of and across the point of the chin



1 2

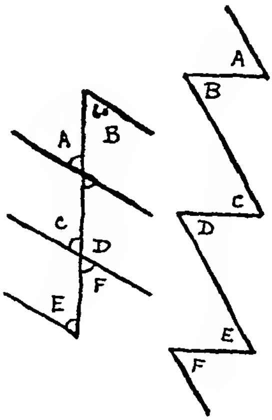
FIG. 5. SAME PATIENT 21 MONTHS LATER

A Z-plastic was done to relax the scar contracture in each nasolabial fold, and the same procedure was carried out on each side beyond the angles of the mouth.

1: Compare this picture with No. 1 of Fig. 4, and note the relaxation of the scars around the mouth.

2: Note the relaxation of the pucker-string scar in the nasolabial folds and also around the mouth and on the chin. Compare with No. 2 of Fig. 4.

The angles of the mouth were lengthened at a subsequent operation.



1. 2.

FIG. 6. SCHEMATIC DRAWING OF A METHOD OF USING MULTIPLE Zs IN CONTINUOUS SERIES

1: Redrawn from Limberg. Three reversed Zs in series are outlined. The incisions are all of the same length, and the arm lines are parallel to each other, and all are at an angle of 60° to the central line, which is continuous. Incisions are made along this outline, and all of these flaps are undercut.

2: Shows the result of the transposition. Note the position of the different flaps and the type of final closure. Marked lengthening can be seen.

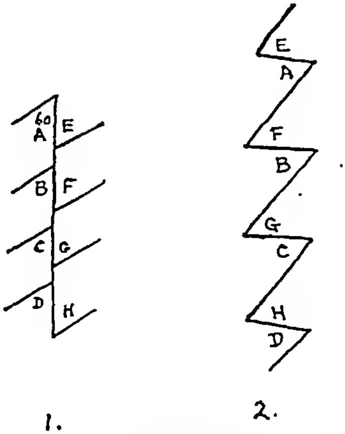


FIG. 7. SCHEMATIC DRAWING OF ANOTHER METHOD OF USING MULTIPLE Zs IN CONTINUOUS SERIES

1: Four Zs in series are outlined. The central line is continuous, the arm lines are parallel and are at a 60° angle, but it will be noted that there is a space between each Z-formation, and that the arm lines are independent and not continuous as in Fig. 6.
2: The type of closure after the flaps are undercut and transposed.

1 2

FIG. 8. ILLUSTRATING THE RESULT OF MULTIPLE Z-INCISIONS IN CONTINUOUS SERIES, IN RELIEVING A DEEP CONTRACTED SCAR GROOVE BETWEEN THE BREAST AND ANTERIOR AXILLIARY LINE

1: Extensive old burn scar. With the arm at the side, the irregular scar can be seen. Relaxation and obliteration of the groove has been accomplished. Note in the lower right hand corner of the photograph the result of a single Z-plastic with incisions 12 cm. long.
2. With arm extended, the full extent of relaxation can be seen, there being no longer any scar pull. The scar is still fairly fresh and has not yet blanched out.

1 2

FIG. 9 ILLUSTRATING THE USE OF MULTIPLE ZS IN RELIEVING SCAR CONTRACTION

1 Burn contracture of many years duration The thumb is drawn toward the palm by a scar band, and the palm itself is contracted There is a contracted scar web between the thumb and forefinger and also between the other fingers A scar hand prevents full extension of the middle finger

2 A Z-plastic was done between the thumb and forefinger One Z was done in the forefinger, two Zs were done on the middle finger, and the commissures between the middle and ring, and ring and little fingers were released by Z-plastics. The ultimate result has been a useful hand.

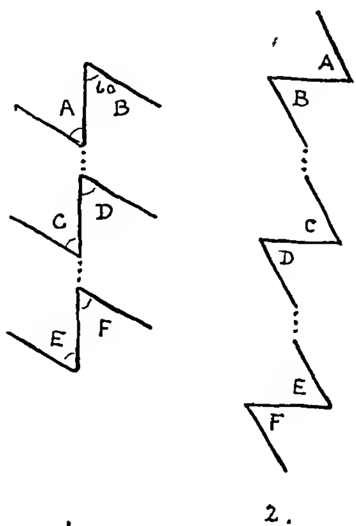


FIG. 10. SCHEMATIC DRAWING OF A METHOD OF USING MULTIPLE ZS IN INTERRUPTED SERIES

1. Three reversed Zs with 60° angles are marked out but instead of having the central line continuous, there is an area of tissue left untouched between the Zs This, indicated by the dotted lines, may be quite short or the distance may be considerable as in long scars

2 Type of closure after transposition of the flaps

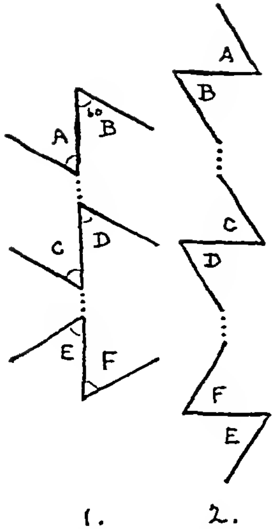


FIG. 11. SCHEMATIC DRAWING SHOWING METHOD OF USING MULTIPLE ZS IN INTERRUPTED SERIES

1. Two reversed Zs and one regular Z are shown. The dotted lines indicate untouched areas between. The Zs may be regular or reversed in any combination desired, the selection of the type depending on the condition of available tissues.

2: Type of closure following the transposition of the triangular flaps formed by the Z-incisions.

1 2

FIG 12 ILLUSTRATING THE RELIEF OF BURN CONTRACTIONS BY EXCISIONS, PARTIAL GRAFTING AND Z-PLASTICS

1· Condition of left arm and axilla after an extensive third degree burn

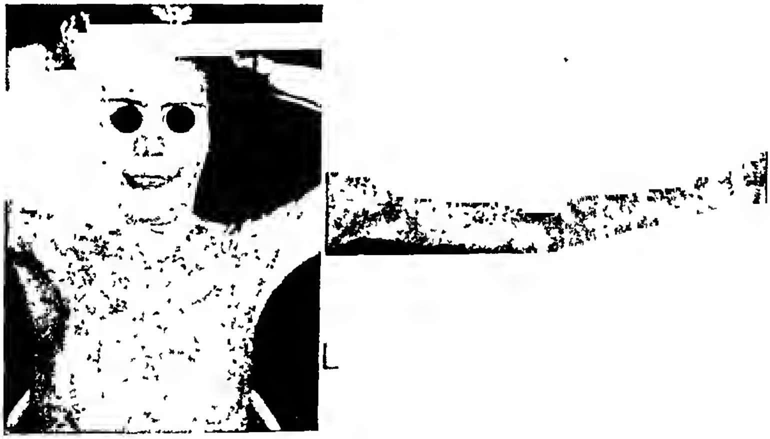
2: The same patient, several years later, after excisions, Z plastics and a skin graft in in the antecubital space. The Zs marked in the axilla, arm, forearm and wrist are to break a long line of scar pull from the axilla to the wrist

PRELIMINARY PREPARATION

It is advisable that every effort be made to put the patient in the best possible physical condition by all available methods before proceeding with operative work. This is particularly important on these patients because some of them have never recovered from the depletion of the original injury. It has also been my custom for many years to delay operation at least six months after healing has taken place, until the scar has fully matured and softened, and the circulation has been improved by time and by physical therapy of one sort or another. Many of these scar contractures are operated on much too early, and frequently Z-plastics fail on this account.

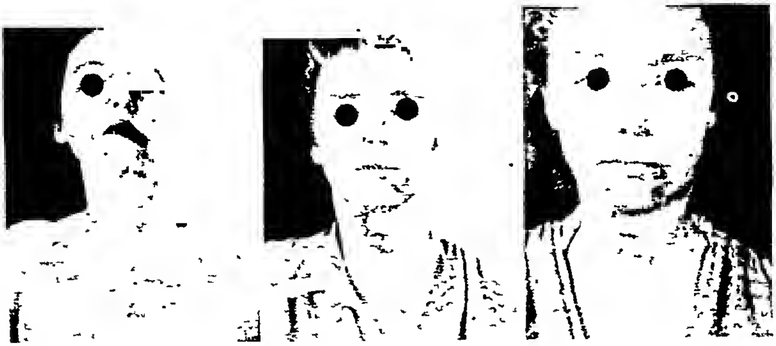
1 2

FIG. 13. (cont.) (From Davis, Pennsylvania Med. J., April 1938). 1: Same marks with arm extended showing the location of the Zs and the long line of scar pull.
2: After the Z-plastics were done and the triangular flaps had been transposed. Note the sutures in place and the relaxation of the scar pull.



1 2

FIG. 14. (cont.) 1–2: Shows the result after 8 years. The left axilla is in good condition, and there is no contracting band checking the elevation of the arm. The long contracture between the axilla and wrist has been permanently relieved by multiple Z-incisions with the transposition of flaps.



1 2

FIG. 15. ILLUSTRATING THE USE OF A MODIFIED Z-PLASTIC IN THE RELAXATION OF SCAR CONTRACTURES OF NECK AND LOWER LIP

1: Four years ago, the patient was severely burned, was skin grafted and had a flap shifted to the neck from the back, elsewhere. She comes in for relaxation of neck and relaxation of lower lip on left side.

2: The binding scar on the neck and chin was excised, and the wound was closed in the shape of an atypical double Z, thus relaxing scar pull. The lower lip on the left side was then raised by a V-Y maneuvre.

1 2

FIG. 16. ILLUSTRATING THE USE OF Z-PLASTICS IN SECURING RELAXATION AFTER THE EXCISION OF AN ULCERATED SCAR BRIDLE

1: Note the prominence of the scar band. It is tightly adherent to underlying tissues. Adjacent tissues show atrophy and depression, and other typical changes due to over treatment with radium. The ulcerated area is covered with a dry adherent crust.

2. Result of complete excision of the ulcerated band with relaxation above and below by Z-incisions with transposition of flaps. Note the healed wound, the filling of the depressed area, and the lack of tension.

ANESTHESIA

Either local or general anesthesia may be used. If local is used, nerve block is preferable to infiltration, as infiltration of scar tissue unequestionably lowers its resistance to infection, interferes with circulation and retards healing. When general anesthesia is used, I have had great satisfaction, during the last several years, with the intravenous use of pentothal-sodium supplemented by gas-oxygen, ether, or cyclopropane, as seems wisest in the individual case.

PREPARATION OF THE SKIN

The skin is prepared by any method in which you have confidence. In my work in recent years, I have been using ether and alcohol followed by several coats of tincture of zephiran.

OPERATIVE PROCEDURE

A brief description of the simplest type of Z-plastic will be described for the benefit of those who may be unfamiliar with the procedure. With the scar bridle under tension, the proposed incisions are marked out with 5% brilliant green in alcohol. The central line of the Z is drawn along the most prominent part of the web and the arms of the Z, which are of the same length, are laid out parallel to each other at the ends of the central line on opposite sides, at about a 60° angle to the central line, making the pattern an atypical Z or reversed Z depending on the condition of the surrounding tissues. The 60° angle between the central and arm lines of the Z has been found to be the most satisfactory angle for practical use, but angles between 60° and 20° can be used depending on the elasticity of the scar infiltrated surrounding skin, on the thickness of the flaps essential to viability and on the location of the contraction and the contour of the part. If unequal angles are used, the arm lines naturally will not be parallel.

When the incisions are made following the marked out Z pattern, two broad based triangular flaps are formed whose bases are opposite each other. These flaps are thoroughly mobilized, binding scar tissue beneath is removed as completely as possible, and all bleeding is carefully checked. It will then be found that the extremities of the central incision draw away from each other by scar pull, the central line becomes longer and the angles become blunted. The flaps are then transposed and are sutured without tension with fine nylon so that their outer margins are in approximation and their tips touch the outer corners of the bases of the opposite flaps. The sutured wound is also Z-shaped, but the Z is turned through approximately 90°, is elongated, and the central line of the original Z now lies transversely across the line of scar pull. Sometimes the tips of the flaps become cyanotic after transposition. A few puncture wounds with a pointed knife may relieve this. Gentle massage toward the bases with the finger tips may be useful. Compresses saturated with cold sterile normal salt solution may also help.

The flaps should be handled with small sharp hooks to avoid injury to the scar infiltrated tissues. Flaps should be thick enough to assure adequate circulation,

but sometimes the tips of dense scar flaps will slough, but this slough is usually on the surface and does little subsequent harm as far as recontraction is concerned.

DRESSING

The sutured wound is dressed with a single thickness of gauze impregnated with 3% xeroform ointment over which is placed several thicknesses of dry gauze and a sterile seasponge thoroughly wrung out, or a mass of fine cotton waste. The whole is secured under even pressure by elastic adhesive plaster and a woven bandage. Loose stitches are removed on the third or fourth day and a similar dressing is replaced. All stitches are usually out by the 10th day. Massage is started after three weeks and is continued for several months.

COMMENTS

Limberg has demonstrated that the 60° angle between the central line of the Z and the arms will give the maximum relaxation, and it is advantageous to use this angle, if possible. However, angles as low as 20° can be used. The actual length of the central line and the arm lines, all of which should be equal, whatever angle is used, depends on the location of the contracture and on the condition of the tissues. These lines vary from 5 mm. in certain areas, such as the angle of the eye, to 15 or 20 cm. or more on the chest or abdominal wall. If smaller angles should be used, then the length of the incisions making the Z should be short. With the angles laid out properly, it can be determined quite accurately before the incisions are made the amount of relaxation, which will be obtained. This can be computed by taking the difference between the length of the long and short diagonals of the parallelogram made by projecting lines across the bases of the triangles marked out by the Z, the short diagonal being the central line of the Z, and the long diagonal being the distance between the distal ends of the arm lines. The actual amount of relaxation, which can be obtained, varies between 50% and 100% of the length of the central line of the Z.

Scar bridles, which are thin and reasonably soft, are utilized in making the triangular flaps. If the bridle is thick and rigid, then this portion is excised, and the margins are drawn together with a few temporary sutures. This sutured wound is used as the central line of the Z. If the scar is deeply grooved, the central line of the Z splits the groove lengthwise, and the flaps are formed just as when a web is present.

When the Z-incision, either single or in series, is used on the fingers or on the wrist or in any region where there is scant tissue to bring in from the sides, then the flaps should be short. Morestin was the first to use Zs in series.

The use of multiple Zs in long contracted scars is very helpful. These Zs may be in continuous series, or an area of scar may be left between single Zs or between Zs in series. There are numerous combinations of the method, but multiple Z-incisions are not being utilized, as yet, as much as they can be, or should be. When Zs in series are used, the flaps must necessarily be short. Frequently when the Z-incision is made and the flaps are mobilized, they naturally transpose themselves and fall into their new positions. Sometimes, however, it is necessary on

account of the unequal scar pull on the two sides of a scar bridle after making the Z-incision to adjust the flaps by secondary incisions in order to close the wound and obtain the desired relaxation. The final sutured wound may be a double Z or some other irregular form of closure. In certain instances, the full amount of relaxation required is not obtained by the first Z-plastic. After six months has elapsed and the tissues have been softened and circulation improved by massage, etc., the same area can be further relaxed by a similar procedure, and this can be repeated, if necessary. This is particularly useful in growing children.

SUMMARY

"By the use of Z-shaped incisions with the transposition of the triangular flaps thus made, satisfactory and effective relaxation can be accomplished in contracted scars with bridles or webs or grooves. Scar flaps which would otherwise have to be excised are utilized and are transposed and sutured in their new positions, thus immediately closing the defect." In other words, scar contractures are relieved by the utilization of scar flaps. In due time, after the relaxation is accomplished, the character of the scar itself changes, and it softens and improves in appearance, and becomes a useful factor in the final result.

The method has for me greatly simplified the problem of scar relaxation, and I prefer to use it, in preference to skin grafting or flap shifting from a distant part in practically every situation in which it can be used.

Unless one is familiar with the procedure and its possibilities, it is difficult to realize how much permanent relaxation can be obtained by the Z-incision with the utilization of the transposed triangular scar flaps.

The operative procedure in suitable cases is simpler than other methods for relaxing scar contractures; tissues are successfully utilized which would otherwise be discarded; the appearance of the area relaxed by this method compares favorably with that of other methods; additional scarring of unscarred areas is avoided; contractions can be permanently relived by this method which would be difficult or impractical to correct by skin grafting. I use the Z-incision constantly and have used it on every part of the body with excellent results, and as a matter of fact could not do without it. It is my considered opinion that the Z-incision with the transposition of flaps thus made is the most generally useful procedure for the relief of scar contractures, and for the readjustment of misplaced tissues, in the entire field of plastic surgery.

BIBLIOGRAPHY

Davis, J. S.: The relaxation of scar contractures by means of the Z or reversed Z-type incision. Anns. Surg., Nov. 1931, p. 871.

Davis, J. S.: The use of relaxation incisions when dealing with scars. Pa. Med. J., April 1938.

Davis, J. S., and Kitlowski, E. A.: The theory and practical use of the Z-incision for the relief of scar contractures. Anns. Surg., June 1939, p. 1001.

Denonvilliers: Blépharoplastie. Bull. Soc. de Chir. de Paris, vol. vii, p. 243, 1856–1857.

Limberg, A. A.: Collection of Scientific Works in Memory of 50th Anniversary of the Medical Post-graduate Institute. Leningrad, p. 461–489, 1885–1935.

Limberg, A. A.: Skin Plastic with Shifting Triangle Flaps. Leningrad, Traumatological Institute, 1929, 862.

Morestin, H.: De la correction des flexions permanentes des doigts, etc. Revue de Chir., vol. L, p. 1, July 1914.

Smith, Ferris: Z plastic operation. Military Surgical Manual on Plastic and Maxillofacial Surgery. W. B. Saunders Co., Philadelphia 1942, p. 37.

RELEASE OF CIRCULAR CONSTRICTING SCAR BY Z FLAPS

THOMAS W. STEVENSON, M.D.

Practically every scar coming to the attention of the Plastic Surgeon is either unsightly or interferes with function because it crosses a joint or skin fold. However, there is occasionally seen a scar which encircles the trunk or an extremity. The resulting disability is generally due to constriction, particularly interference with circulation.

Two types of circular constriction have been seen; congenital and traumatic. The congenital ones are more numerous and varied. The toes and fingers are most frequently involved and this defect is usually associated with webbing and absence of one or more phalanges. Sometimes these are thought of as intrauterine amputations and the constriction rings therefore regarded as near amputations. Faint white scar lines are often seen around the lower legs of patients with these deformities of the toes. In my opinion these are wrongly ascribed to intrauterine trauma or amniotic bands. There are too many other associated anomalies such as ankylosis or absence of several cervical spine segments, absence of pectoral muscles, or deformities of the scapula. It is seldom possible to explain these anomalies.

A constricted digit presents a characteristic appearance. Near the base is a deep sulcus which may extend down to bone. The distal part is usually red or dusky compared with normal surface color. This indicates interference with return of venous blood. In the example being presented there was also lack of adequate arterial supply and absence of nerves or muscles passing through points of constriction.

When this patient was born in 1936 he was found to have webbed fingers lacking one phalanx each. Several toes of the right foot were absent including the great toe, and a bulbous remnant of the third toe was encircled by a deep ring. There were two faint scar lines around the right leg without depression. Just below the left knee was a sulcus extending to bone on all sides. A similar ring was present just above the ankle. The os calcis and heel pad were present but the anterior part of the foot was absent.

When I saw this patient in January 1938 an attempt had been made to relieve the upper constriction by a circular excision and suture of the skin as an end to end anastomosis. As expected the constriction returned to its original condition. Distinct differences in surface temperature were noted; the thigh was normally warm; the calf was cool and the foot cold. Because of the weight bearing possibilities of the heel it was decided to attempt improvement of the leg rather than to amputate it. Three Z flap procedures were done on the upper ring at intervals of two to three months. The skin and bone were the only structures continuing through the constriction, and at the time of the previous circular excision all circulation to the lower part must have passed through the bone. After the second Z

FIG 1 CONGENITAL CONSTRICTION RINGS—#1

FIG 2 CONGENITAL CONSTRICTION RINGS—#2
Upper ring partially relieved by Z flap

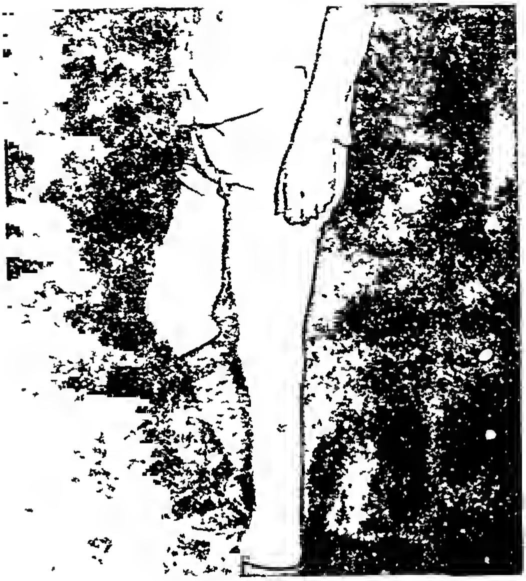
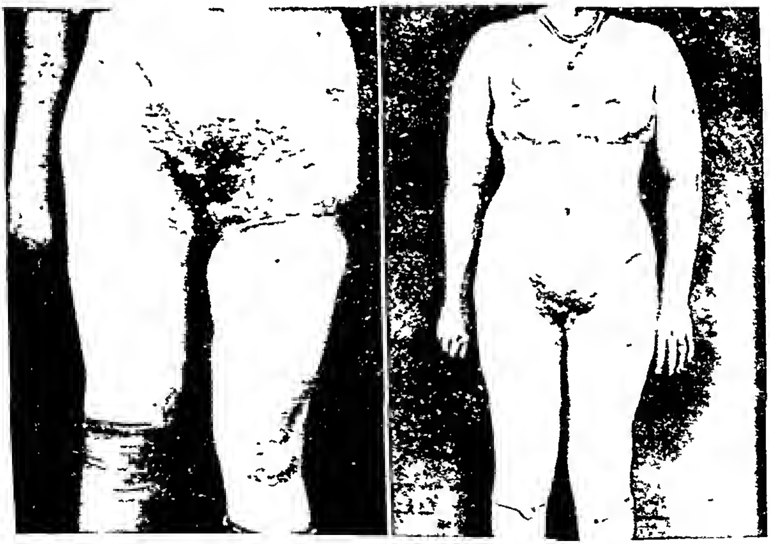


Fig 3 Congenital Constriction Rings—#3
Completed release of both rings



1 2

Fig 4 Cicatricial Constriction of Left Thigh—#1 and #2, before and after Z Flap, Front View

the calf was less edematous and was warmer. After the ankle had been repaired the foot was warm.

The boy has been able to develop good thigh musculature. He wears a built-up shoe and brace strapped below the knee (see pigmented pressure area on lateral surface of leg). He runs, skates and rides a bicycle. The heel pad bears full weight without trouble and function is far better than could be obtained by means of an artificial limb. Gradually he has regained sensation down to the ankle.

3 4

FIG. 5. CICATRICAL CONSTRICTION RING OF LEFT THIGH—#3 AND #4, SIDE VIEW BEFORE AND AFTER Z FLAP

The second case is an example of a constricting scar due to trauma. This patient suffered a severe burn of the thighs and buttocks when she was 4 years old. When operated upon in 1939 she was 30 years old. She sought care at this time because of recurrent ulceration in the bottom of the constriction, increasing edema of the leg and numbness of the leg. When first seen there was an extensive cellulitis of the gluteal region. When this subsided the gluteal scars were excised and the wounds covered by split grafts. This did not relieve the anterior constriction so in August 1939 a Z flap procedure was done. Both flaps contained scar tissue which prevented a smooth post-operative scar, but the general contour of the thigh was restored and the constriction relieved.

RECONSTRUCTION OF THE CONTRACTED AXILLA[1]

LEON E. SUTTON, M.D.

Scar contractures of the axilla frequently follow burns involving this region. The most common method of reconstruction consists of slitting the contracture bands transversely and inserting a split graft or a flap from the chest, abdomen, or back. The purpose of this paper is to present a procedure designed to obtain complete relaxation of the contracted axilla in one operation without the use of skin grafts or flaps from a distance.

Since the advent of the Dermatome and other devices which simplify the cutting of skin grafts, there has been an increased tendency to apply grafts when other methods might give better results. In the face, where appearance is as important as function, grafts or flaps should never be applied until all available adjacent skin has been utilized. Below the neck, where function is the first consideration, the same rule applies.

Contractures about the joints can often be relaxed by means of the "Z" plastic with or without the addition of a split graft. If tendons are exposed, a flap must be considered instead of a graft. If relaxation is not complete, scars tend to crack and become ulcerated, motion is limited and muscular and bony development retarded. Complete relaxation without too much delay is especially important in children. It is usually possible, however, to delay reconstruction long enough for the scar to fade, soften and stretch.

After a deep burn of the axillary region has healed, with or without grafting, the scar or grafts contract, limiting abduction usually below the shoulder level. After six months or a year, if free use of the arm is permitted, the scar tissue will stretch producing a web from the chest wall to the arm which, in time, possesses fairly good circulation and may be utilized in the reconstruction. Even in children, it is usually possible to obtain complete relaxation after the lapse of a year without damage to muscles, nerves or vessels. Scar tissue which has softened and stretched will not contract when shifted if no necrosis of the flaps occurs. New contracture bands will not be produced if the flaps are shifted across the lines of pull and the new scar lines are staggered. Necrosis of scar flaps may be avoided by cutting thick, short, wide, roundpointed flaps, handling them carefully and suturing without tension. It is much easier to split the axillary web transversely and apply a Dermatome graft. This may be necessary when the web is short or if reconstruction must be done before the scars have softened and stretched. However, very thick grafts may not take completely. All grafts shrink and the thinner grafts may shrink so greatly as to almost produce the original condition, making a later operation necessary to obtain full relaxation.

The "Z" plastic is of great value in increasing the distance between two points. In the axilla, the "Z" pinciple is often difficult to apply throughout because of

[1] Read at the Annual Meeting of the American Society of Plastic and Reconstructive Surgery, New York City, October 11, 1945. From the Division of Plastic Surgery, Syracuse University College of Medicine and University Hospital.

the width of the scar web and the fact that angles change when incisions are made and tension is relieved. In the present series of cases, interdigitated flaps have been more useful than the "Z" method which has been employed only at the ends

Fig. 1 (Case 1). Burned in May 1938
Early grafting done elsewhere. Preoperative Photo September 1939

Fig. 2 (Case 1). Result 2 Months after Plastic Operation Done in November 1939

of the scar web to avoid the unsightly puckering which tends to occur at those points.

OPERATIVE PROCEDURE

With the arm held in abduction, an incision is made along the free edge of the axillary scar web from the arm to the body wall. Dissection is carried down mid-

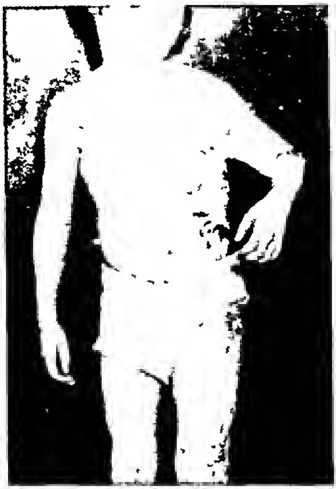


FIG. 3 (CASE 2). BURNED IN FEBRUARY 1940
Photo shows condition in September 1940 before operation

FIG. 4 (CASE 2). THREE MONTHS AFTER INTERDIGITATION OF FLAPS DONE IN SEPTEMBER 1940

way between the flaps to the deep fascia on the arm and chest wall. Dissection of the apex of the axilla is completed after the flaps have been split to allow better exposure. The anterior flap is then incised from the free edge of the web to the

apex of the axilla, the incision extending somewhat beyond the edge of the pectoralis major muscle. Two similar incisions are made in the posterior lamella to produce a flap which will fit into the opening created by the previous incision.

FIG. 5 (CASE 3) CONTRACTURE OF AXILLA RESULTING FROM BURN IN NOVEMBER 1941

FIG. 6 (CASE 3). SIX MONTHS AFTER PLASTIC OPERATION DONE IN MAY 1945

This posterior flap should be wide enough to cover the apex of the axilla and long enough to extend well over the free edge of the pectoralis major. These incisions open up the axilla so that the dissection may be safely completed. Most of the

axillary fascia and all deep scar tissue must be removed, exposing the axillary vessels and nerves if necessary. The intercosto-brachial nerve may be sacrificed. The edge of the latissimus dorsi posteriorly and the pectoralis major anteriorly

Fig 7 (Case 4) Result of Burn in February 1938
Photo taken June 1940

Fig. 8 (Case 4). Condition Two Months after Operation

should be exposed and the deep fascia over these muscles removed if it is tight when the arm is abducted. As the dissection proceeds, the arm should be slowly abducted to the full extent. If the muscles are tight, it may be necessary to nick

the tendons of the pectoralis major and latissimus dorsi. Dissection should continue until all tension is relieved. Further skin incisions are so placed that alternating anterior and posterior flaps will be formed, the flaps on one side fitting into the angles between the flaps on the opposite side of the chest and arm. The angles into which the flaps fit may be widened by short, diverging cuts at the apex of the angle with excision of the intervening tissue. The points of the flaps are then trimmed to fit and sutured in place.

POST-OPERATIVE CARE

The axilla is drained for forty-eight hours through a posterior stab wound. The arm is dressed at the side with the elbow at ninety degrees and is not abducted until the skin is healed, from two to three weeks. Paralysis of the extremity may follow improper dissection, sudden or forceful abduction, or tight dressing around the arm or of the arm against the body. Use of the arm should be encouraged as soon as healing is complete. Hanging by the hands from a bar placed in a doorway will hasten return of function.

Twelve cases of axillary contractures are presented. The method outlined above was used in these cases attaining complete relaxation in one operation without the use of skin grafts of flaps from a distance.

EARLY COVERING OF EXTENSIVE TRAUMATIC DEFORMITIES OF THE HAND AND FOOT[1]

JOSEPH J. McDONALD, M.D., AND JEROME P. WEBSTER, M.D.

From the Division of Plastic Surgery, Department of Surgery. Presbyterian Hospital and College of Physicians and Surgeons, Columbia University. New York, N. Y.

To convert an open wound into a closed wound as soon as possible is a fundamental surgical principle. In the treatment of traumatic deformities of the hand and foot this objective is second in importance only to life-saving measures such as the treatment of shock, control of hemorrhage, and the investigation of potentially serious injuries of the head, chest, and abdomen.

When no complicating factors are present, the surgeon's primary objective should be the early closure of the wound by the most practical means at his disposal, and even when associated injuries of a serious nature are present, the same objective should be sought as early as possible. When it is impractical to close the wound immediately, primary healing can still be attained in many instances by secondary closure within a period of several days. Speaking from wartime experience, Colonel Churchill (1) has aptly termed the interval from four to ten days following injury as the "golden period" for wound closure.

The penalties for neglect in covering open wounds of the hand and foot are frequently permanent and costly. The loss of skin usually exposes fascial planes, tendons, nerves, and bone and joint surfaces. Failure to cover these raw areas at an early date may condemn the patient to a long period of healing with the formation of granulation tissue, contracture, sloughing of tendons, osteomyelitis, and suppurative arthritis. Treatment is markedly complicated and prolonged if this sequence of events is permitted to occur, and disability may become permanent. Later reconstructive measures in these cases may bring about satisfactory results, but repair is more difficult and function may be reduced. Some of the problems arising under such circumstances are illustrated by the following case (operated by J. P. W.):

Case 1. N. T., No. 651534, a six year old schoolboy, sustained a severe crushing injury to the right hand on December 13, 1940, when he was struck by a trolley car. Initial treatment was administered at a nearby hospital. The index finger was crushed and partially disarticulated, the third, fourth, and fifth fingers had been amputated at the distal half of the proximal phalanges, and the skin was avulsed from what remained of these fingers and from the adjacent portion of the dorsum of the hand. The palmar skin was avulsed back to the distal flexion crease. A primary irrigation and debridement was done and the wound allowed to granulate. During the ensuing weeks several attempts were made to hasten healing with the aid of small deep grafts. Later he was referred to the Presbyterian Hospital for reconstructive surgery.

When first seen in the Plastic Surgery Clinic, August 15, 1941, eight months after injury, the stumps of the four amputated fingers of the right hand were bound together by a conical mass of scar tissue with a small ulcer at its apex (fig. 1, A–B). No individual motion of these fingers or their metacarpals was possible. Although the thumb was not involved, the

[1] Presented before the American Society of Plastic and Reconstructive Surgery, October 12, 1945, New York, N. Y.

grasping ability of the hand was greatly reduced, and the scar epithelium over the stumps of the fingers was thin and tender.

A program of reconstruction was then undertaken, using a pedicle flap from the abdomen to replace the scarred stumps (fig. 1, C). The metacarpals were then separated in succession, by deepening their webs with inserts of split skin grafts, thus increasing the apparent

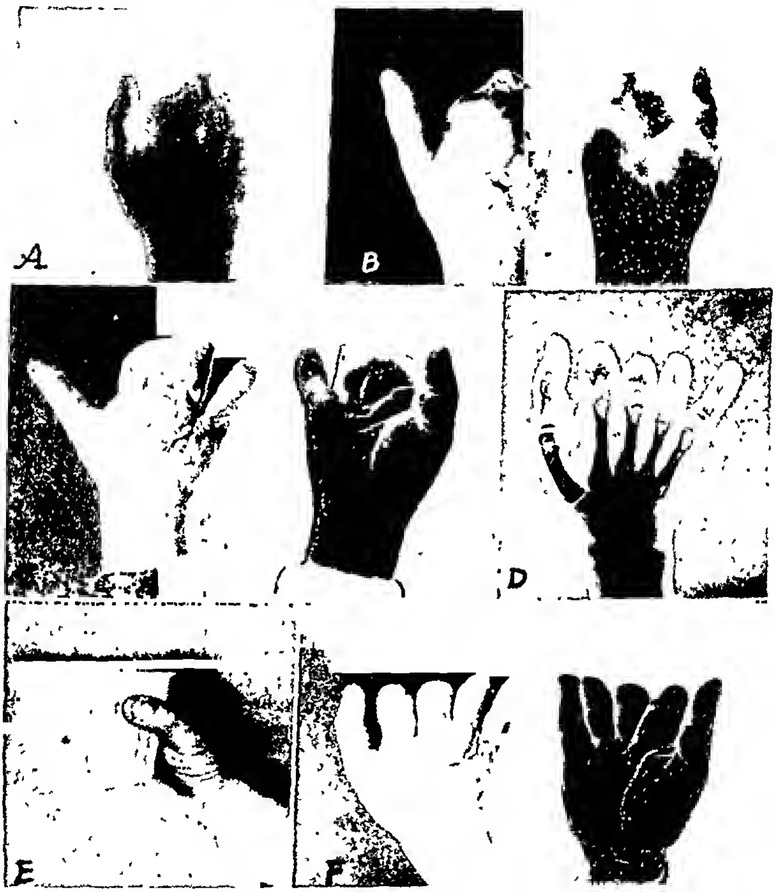


FIG. 1. TRAUMATIC AMPUTATION OF FINGERS BY TROLLEY CAR WHEEL
(A) X-ray and (B) surface views of scarred hand eight months after injury with yet unhealed ulcer at apex of conical stump. (C) After transfer of abdominal pedicle graft and separation of fifth finger. (D) X-ray after interdigitation of remaining fingers. (E and F) Completed reconstruction showing improved function and apparent length added to fingers by the splitting of the metacarpals.

length of the fingers and improving their mobility (fig. 1, D–F). The reconstruction entailed four hospital admissions over a period of 15 months. Thus, for a period of nearly two years the patient was markedly handicapped by his injury and forced to miss considerable time from school. Much time could have been saved and the permanent disability might have been less, if early covering of the original wound had been accomplished.

Such complications can be largely eliminated if, after careful debridement, early covering of the denuded areas is done. A number of techniques are available to the surgeon and a method applicable to the individual case at hand should be selected. Where viable skin flaps remain, and these can be closed by suture without undue tension, this is the simplest and most practical means. For covering larger denuded areas a split thickness skin graft can be used and may afford an adequate permanent covering, particularly when the exposed tissue is predominantly fat or muscle. In instances where joints are opened and nerves, tendons or bone fragments exposed, such structures can sometimes be covered by shifting an adjacent flap of healthy skin and fat, and the bed of this flap then covered with a split skin graft.

For wounds with extensive loss of surface tissues which would ultimately require pedicle flaps to afford maximum restoration of structure and function, it is often possible to apply an immediate pedicle flap, particularly in cases of hand injuries, and thereby effect a marked saving in time. When the immediate use of a pedicle graft is not practical, early closure with a free graft should be done, for even in cases of exposed joints, bones and tendons, a good take of a split thickness graft can often be attained. With early healing by means of a split graft, the replacement with a pedicle flap can soon be safely carried out.

When concomitant serious injuries to other parts of the body make it necessary to postpone definitive treatment of the hand or foot injury, or when the local injury is so extensive that gangrene or infection is feared, closure of the wound should be delayed, and the immediate local treatment limited to debridement of non-viable tissue and the application of a non-adherent pressure dressing with immobilization. Chemotherapy, particularly the use of penicillin, is an important prophylactic measure and should be instituted. After four or five days, if there are no signs of infection, and with the patient out of danger, tissues still of questionable viability may be excised and the wound then covered with a split skin graft or a pedicle flap. With extensive local damage and marked contamination this procedure may prove the safest and most satisfactory.

The following group of cases is presented as examples of the above techniques:

I. EARLY COVERING WITH SPLIT SKIN GRAFTS

Case 2. C. F., No. 673359, a twelve year old school boy admitted to the Presbyterian Hospital March 17, 1945, with a fresh crushing injury of the left hand which had been run over by a trolley car. There was a traumatic amputation of the fourth and fifth fingers near the base of the proximal phalanges. The skin was avulsed from most of the third finger and part of the second finger and from the distal half of the dorsum of the hand. The web between the thumb and index finger was deeply lacerated. The proximal phalanx of the third finger was fractured and there was a compound dislocation of its metacarpal phalangeal joint (fig. 2, A–D).

Because of a questionable skull fracture and associated head injury, the immediate treatment of the hand injury was limited to debridement of the wound, suture of the loose skin flaps, and immobilization with a fluff-gauze pressure dressing. Oral sulfadiazine was started. The patient remained afebrile and no signs of cerebral damage appeared. On the fifth day after injury, under general anesthesia, the wound was exposed and "redressed with skin" using a split thickness graft from the right hip (fig. 2, E–F). A satisfactory take of the graft was obtained and on the eighteenth day after injury he was discharged from the

hospital. Active exercises were soon started and the patient had regained good use of the hand within six weeks after injury (fig. 2, G–I).

He was readmitted to the hospital in September, 1945, for six days at which time a revision of the amputation stumps was done to round off the ulnar side of the hand, and a Z-plastic performed on the scar acress the web between the thumb and index finger The result is a still better functioning and a better appearing hand (fig. 2, J–K)

FIG. 2. TRAUMATIC AMPUTATION OF 4TH AND 5TH FINGERS BY TROLLEY CAR WHEEL

(A and B) Appearance of fresh wound upon admission to the hospital (C and D) After debridement and suture of loose skin flaps (E) At the time of skin grafting five days after injury (F) Appearance of skin graft 10 days later (G, H, and I) Six weeks after injury. (J and K) After revision of ulnar side of hand and Z-plastic on web between thumb and index finger

In contrast to case 1, this patient with a comparable injury required only 24 days in the hospital for initial and definitive care In addition to a marked saving in time, early closure of the wound afforded him a maximal saving of tissue and function

The following case, operated upon by Dr. R. H Clifford of the Plastic Surgery Service, illustrates the use of an immediate split-thickness graft on a fresh wound:

Case 3. H. C., No. 561786, a six year old school boy admitted to the Babies Hospital on May 24, 1945, with a fresh avulsing injury of the right foot which had been run over by a truck in a street accident. The skin over the medial aspect of the foot and a portion of the lower leg had been abraded beyond salvage (fig. 3, A). Treatment consisted of debridement of the wound and the immediate application of a Thiersch graft from the thigh (fig. 3, B). The graft took well except for a small area over exposed bone on the medial malleolus. A superficial sequestrum separated from this area after a few weeks, and spontaneous healing then took place. The total period of disability was two months. No revision of the wound was necessary.

II. EARLY COVERING WITH PEDICLE GRAFTS

The following two cases were operated upon by one of us (J. J. McD.) under the direction of Dr. T. W. Stevenson.

Case 4. E. M., No. 779724, a fifty-one year old female war plant employee, was admitted to the Presbyterian Hospital on March 23, 1945, with a fresh traumatic amputation of the thumb and index finger of the right hand through the metacarpals. The hand had been

Fig. 3. Avulsing Injury of Right Foot Run Over by a Truck
(A) Appearance upon admission to hospital shortly after injury. (B) Healed primary Thiersch graft two months later.

crushed in a machine used for pressing out torpedo fins. Skin was avulsed from the proximal portion of the third finger and from the adjacent portions of the dorsum and palmar surface of the hand (fig. 4, A–B)

Treatment consisted of irrigation and debridement of the wound and the immediate application of an abdominal pedicle flap. Eighteen days later the pedicle was divided and the abdominal defect closed with a split thickness graft from the left thigh (fig. 4, C–F) The patient was discharged from the hospital 32 days after injury completely healed (fig. 4, G–H).

Case 5 H W, No 783381, a thirteen year old school boy admitted to the Presbyterian Hospital on May 18, 1945, with a fresh explosion injury of the left hand. The injury had been caused by the explosion of a test tube containing red phosphorus and potassium chlorate The terminal portion of the index and middle fingers had been blown off, and the soft tissues avulsed from the proximal portions of these fingers and from the terminal portion of the thumb The first metacarpal was fractured near its base and its shaft displaced into the palm The web between the thumb and index finger had been deeply split and the adductor pollicis muscle largely destroyed There were lacerations in the palmar surface of the hand and on the volar pads of the fourth and fifth fingers (fig 5, A–C). In addition,

there were numerous small puncture wounds of the right thigh, neck, and face caused by flying glass particles. Both eyes were involved.

Initial treatment of the hand injury consisted of debridement of the wound and the immediate application of an abdominal pedicle flap to the avulsed areas on the thumb, index

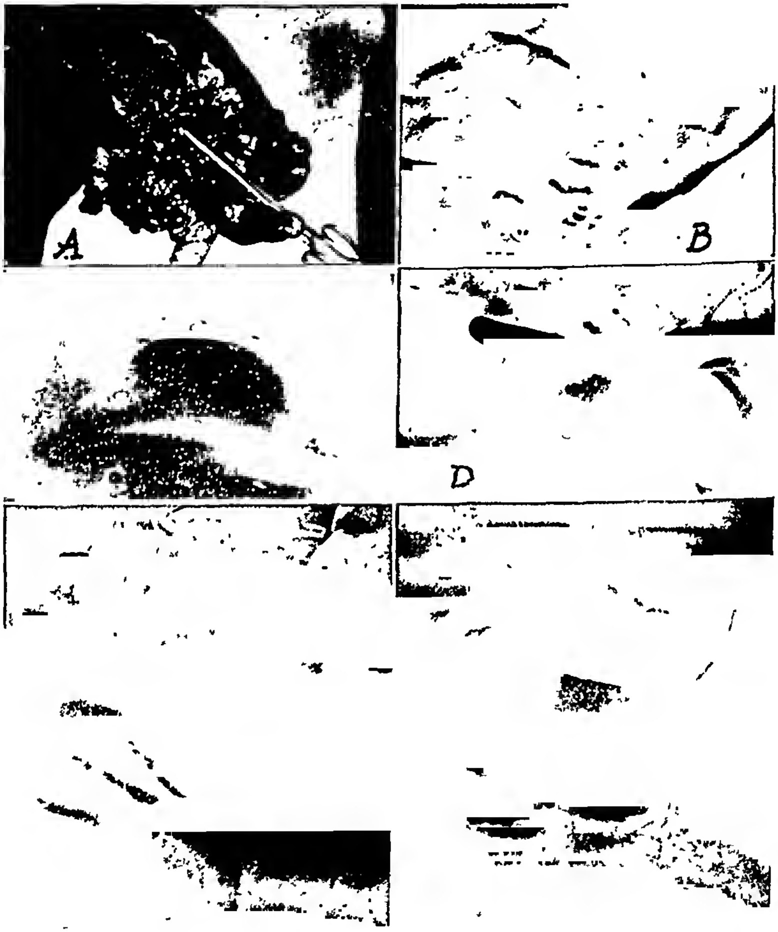


FIG. 4. TRAUMATIC AMPUTATION OF THUMB AND INDEX FINGER IN AN INDUSTRIAL ACCIDENT

(A) Appearance upon admission to the hospital with thumb and index finger hanging by one shredded flexor tendon. (B) After preliminary washing and debridement. (C) Abdominal pedicle flap which was applied immediately. (D–F) At time of division of pedicle graft 18 days after injury. (G–H) Completely healed graft.

and middle fingers (fig. 5, D). The lacerations of the face and right thigh were debrided and small particles of glass removed from many of them. Simultaneous treatment of the ocular injuries was carried out by the Department of Ophthalmology. Penicillin was given for a period of ten days.

Subsequent transfer of the pedicle graft of the fingers was carried out in four stages (fig. 5, E–G). The patient was discharged two months after injury with all wounds healed, though reconstruction was not yet complete. He was readmitted in September, 1945, for a period of nine days at which time the pedicle covering the index and middle fingers was divided to individualize these fingers. The pntient was already able to make considerable

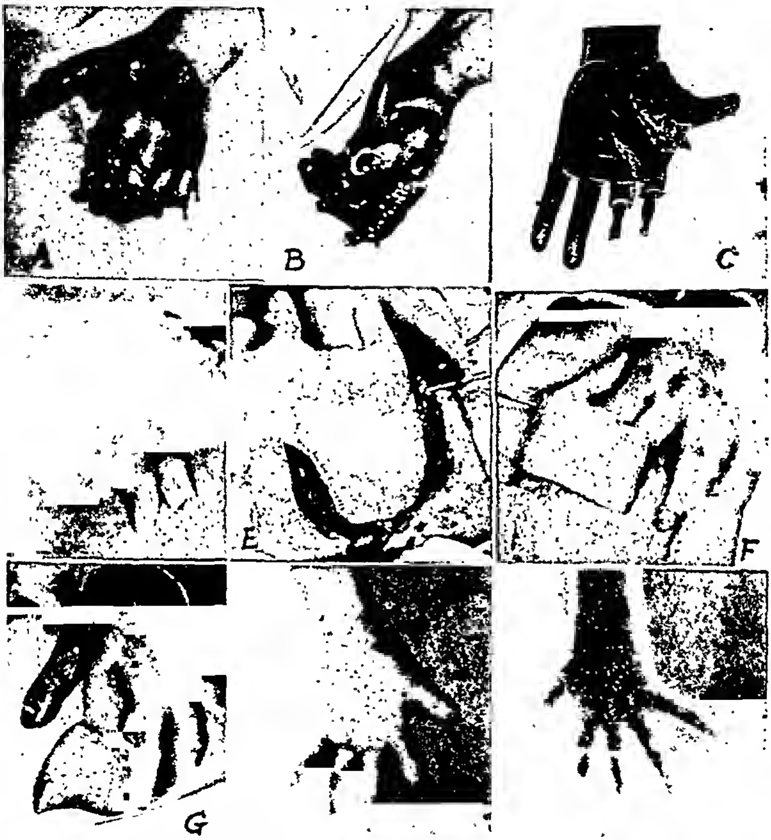


FIG. 5. AVULSING INJURY OF LEFT HAND FROM CHEMICAL EXPLOSION

(A–B) Appearance upon admission to hospital shortly after injury. (C) Diagram showing extent of soft tissue loss and displacement of fractured metacarpal of thumb. (D) Immediate abdominal pedicle graft. (E–G) Stages in division of abdominal pedicle graft. (H–I) After separation of fingers and removal of excess fat from graft.

use of this hand. Two subsequent revisions were needed to complete the thinning out of excessive fat from these fingers (fig. 5, H–I).

By the use of early covering of avulsed surfaces in the case it was possible to save the length and function of two fingers and the thumb, and thus avert a crippling deformity. Since the patient was a left-handed individual this saving was of even greater importance to him.

III. EARLY COVERING WITH A SPLIT GRAFT AND LATER REPLACEMENT WITH A PEDICLE FLAP

Case 6 S. H., No. 762861, an eight year old school boy admitted to the Fracture Service of the Presbyterian Hospital on October 30, 1944, with a fracture-dislocation of the ankle

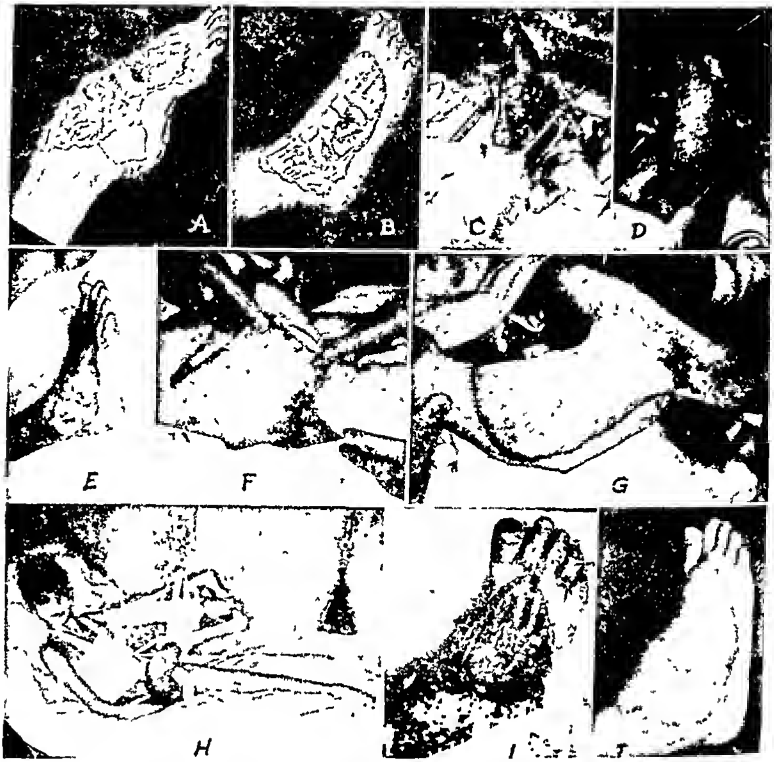


FIG. 6 COMPOUND AVULSION AND FRACTURE-DISLOCATION OF FOOT WHICH HAD BEEN RUN OVER BY A TRUCK

(A) Diagram of injury based on tracing from admission X-ray. (B) Diagram of injury after primary debridement and reduction of misplaced bones (C–D) Five days after injury showing application of split-thickness graft (E) Healed graft three weeks later. (F) Attachment of thoraco-abdominal pedicle graft to left wrist which was used as carrier. (G) Transfer of pedicle flap to replace split-thickness graft on dorsum of foot. (H) Showing method of immobilization and suspension used during 24 day period of wrist-to-foot attachment. (I) Foot at time of division of pedicle from wrist. (J) Healed pedicle graft ready for stabilizing orthopedic procedures

and mid-tarsal joints of the right foot and an associated avulsion of skin and soft tissues from the dorsal and lateral aspects of the foot (fig. 6, A–B). The patient had been struck by a truck while running across a city street There was a fracture of the medial side of the distal tibial epiphysis. All mid-tarsal bones were in abnormal relationship to themselves and to the tibia, and all mid-tarsal ligaments were ruptured and their joints opened Raw

bone had been planed off the talus, calcaneus, cuboid, and third cuneiform. The extensor digitorum longus tendon was gone at the musculo-tendinous junction, the extensor digiti brevis was missing, and the peroneus tertius and brevis tendons were torn. The peroneus longus tendon was intact, as were the tendons of the tibialis anterior, posterior, and extensor hallucis longus.

Immediate treatment consisted of debridement of the wound, reduction of the fracture-dislocations, immobilization by means of a Roger Anderson apparatus, and application of a non-adherent pressure dressing. Penicillin was started and continued for twelve days.

On the fourth day after injury the patient was seen in consultation by the Plastic Service. He was afebrile and inspection of wound revealed it to be clean. On the following day a split thickness graft from the left thigh was applied to the wound. Primary healing was attained and infection avoided (fig. 6, C–E). Four weeks after grafting the Roger Anderson apparatus was removed and a plaster encasement applied. He was soon able to leave the hospital on crutches and was sent home for a period of two months to allow for firm bony union.

In order to render reconstruction and stabilization of the foot possible, and to provide a more durable covering for the dorsum of the foot, it was decided to replace the thin graft with a pedicle flap. He was readmitted to the hospital in February, 1945, and a pedicle flap was raised from the right thoraco-abdominal region. Using the left forearm as a carrier, the pedicle was then transferred to the right foot (fig. 6, E–J). This required seven operations over a period of 12 weeks.

He was then discharged able to walk with a special shoe fitted with a spring brace to overcome the tendency to foot-drop.

He has since been readmitted to the Fracture Service and the tibilalis posticus tendon transplanted to the lateral surface of the foot.

By early covering of this wound it was possible to salvage a maximal amount of tissue and to proceed rapidly with reconstructive measures.

In comparing the management of these cases it is immediately apparent that proper treatment can be instituted only when the services of a surgeon trained in plastic and reconstructive work are available from the beginning. The impression that the plastic surgeon can always be called upon later to salvage and restore the damage deserves contradiction. It is the policy at the Presbyterian Hospital for the Plastic Service to be consulted on all emergency cases in which there is loss of tissue, and by following this simple rule adequate early treatment is always available for cases of the type herein presented.

SUMMARY

1. In dealing with extensive traumatic deformities of the hand and foot, the importance of converting an open wound into a closed wound as soon as practical is stressed.
2. The complications resulting from neglect in early treatment are reviewed and an illustrative case cited.
3. Several techniques involving the use of split thickness grafts and pedicle flaps to obtain early covering are discussed.
4. Cases illustrating the application of these techniques are presented.

REFERENCE

1. Churchill, Col. Edward D.: The surgical management of the wounded in the Mediterranean Theater at the time of the Fall of Rome. Ann. Surg., 120: 268–283 (Sept.) 1944.

LOSS OF COVERAGE OF THE PENIS, SCROTUM AND URETHRA

DAVID W. ROBINSON, M.D., KATHRYN L. STEPHENSON, M.D., AND EARL C. PADGETT, M.D.

From the Surgical Department of the University of Kansas School of Medicine

Loss of skin covering of the penis and scrotum presents difficult technical problems of reconstruction. Careful consideration as to the time of closure and methods of repair must be given. A good functional result can be given in most cases if good judgment is used in planning the operation. These cases are rare but, as modern machinery has been developed in which cog wheels, etc., are installed, the percentage of cases seen are on the increase.

A review of the literature, however, reveals that in the past only about fifty of these cases have been reported. Owens, in reviewing the literature in 1942, found thirty-four cases of penile, scrotal skin, and subcutaneous denudation of which thirteen were total losses. Of the total avulsions most of the accidents have been caused by clothing being caught in revolving machinery and thus tearing off of the skin of the genitalia by a rapid twisting process. Some large sloughs of this type have been associated with severe infections (figs. 4 a, b, c, d) or, following war injuries in particular, rupture of the urethra accompanied by extravasation of the urine may occur. In war time, bullets, shrapnel, etc., not uncommonly take off a part of the penile structure or even the scrotal structure but usually in these cases the amount of skin lost is not so striking as in cases of avulsion seen in civilian life. Especially in war injuries but also occasionally in civilian injuries the urethra may be partially destroyed. This further complicates an already difficult situation insofar as reconstruction is concerned. During the years of and since World War I (E. C. P.) and World War II (D. W. R.) we have come in contact with some cases which represent most of the types of injuries just mentioned.

OUTLINE OF TYPES OF CASES LIKELY TO BE SEEN

To establish orientation on this subject immediately, it might be well to itemize briefly certain conclusions. For the reconstruction of loss of penile skin covering alone two methods are applicable and depend somewhat on the extent of the damage. When the injury is incomplete one may obtain and surround the penis with a flap from the scrotum. A skin flap from the scrotum is fairly thin and pliable and has the disadvantage only of too much hair. A flap from the thigh or abdomen is too thick to be advantageous and does not expand enough in the case of erection. Flaps from certain other parts such as the pubis have the disadvantage of containing hair. In some instances the disadvantage of excessive hair can be overcome by the application of an electric current to the hair follicles. In many cases especially when the loss of skin and subcutaneous tissue has been considerable, we prefer the application of a moderately thick skin graft to gain coverage immediately. As a rule, a second operation in which the skin graft is put on in tunnel fashion will have to be done so that sufficient skin surrounds the penis to allow easy erection. These tunnel skin grafts are placed in

lengthwise fashion and sutures are placed over a stent so that as much new skin is applied as possible. This usually results in a good take because one is working with a healed clean field after the primary coverage of skin. When this is completed, this method gives a coverage which looks nearly normal and the function is good (fig. 7 a, b).

When both the penis and scrotum are denuded of skin we have come to the conclusion that the method just described for covering the penis with a skin graft should be used as soon as possible. At the same time the testes should be implanted on their respective sides beneath the skin of the thigh fairly well back and down as far as possible. In the lower end of the skin flap a bridge of skin and subcutaneous tissue is left to be cut about ten days later when the blood supply from the upper end to the flap is assured. This completes the first stage. At a second stage flaps are outlined over the buried testes with a base at the upper part of the flap, the lower part of the flap having been entirely cut at a previous time. Then, at the same or a later date if judged necessary, both flaps are turned inward along with the covered testicles, vas deferens, and vessels if they have been uncovered. The areas from which the flaps are removed from the thighs are covered with split skin grafts. When the flaps are drawn together along with the inserted testicles a good scrotum can be rebuilt (figs. 6 and 7).

In some cases one not only has a skin defect but part of the corpora may be lost and the urethra may be opened with a portion missing. In such cases it is necessary first to re-establish the urethra as one would do in a hypospadias operation. In passing we should like to emphasize that when one re-establishes a urethra the urine should be diverted. After a good many experiences in hypospadias operations unless the hole is extremely small we have come to the conclusion that an intra-urethral catheter for carrying the urine probably does more harm than good. A catheter seems to excite the remaining urethra so that infection develops and opens up the sutured defect. In the case which we are presenting (fig. 5) a posterior urethrotomy was performed but a catheter was also placed in the anterior urethra. A favorable result occurred however, due to luck and not to good judgment. For the coverage and repair for loss of the cavernosa a little thickness is desirable and in such a case we believe a skin flap is superior to a skin graft.

The question arises whether or not the eventual insertion of some cartilage beneath the skin flap is a procedure of value. We have not had any experience with the insertion of cartilage in such cases but the thought has occurred to us that it might aid in preventing the lateral curvature of the penis on erection. However, if the scar tissue is thoroughly removed and the skin flap is a fairly broad one, lateral curvature may not be any great functional disadvantage. Frumkin, a Russian surgeon, constructed some whole penises by means of a tubed skin flap in which cartilage was inserted. The cartilage was inserted down into the lower part of the corpora cavernosa which, when dilated in the erectile stage, gave some semblance of a functional penis although sensation in the glans was lacking. We have had no experience with this particular operation but in certain cases where the whole penis is lost and one has sufficient time, as in the army, we see no reason why this operation should not be attempted. The psychic reaction

of the patient would probably be improved even if the functional result were somewhat deficient.

We have one case in which a circumcision was done. To stop bleeding during the operation a rubber band was placed around the base of the penis. The surgeon forgot to remove the rubber band after the completion of the operation and the whole penis sloughed off. This occurred in a small child (case I). Nothing was done concerning the matter when the child was seen by the plastic surgeon. This case was seen more than twenty years ago and at that time the method of Frumkin to which we have just alluded was unknown Later when adult life was reached his operation might be applicable.

Occasionally one sees a case in which a large stricture of the urethra of some length has formed due to injury or some lesion. There is no way to control completely these long strictures. As a matter of fact, permanent urethral dilatation is often impossible even if carried on periodically. For the repair of this type of case we feel there is only one method which is permanent and effective. One must expose the urethra posterior to the corded stricture and sever the stricture internally. This procedure is followed by the insertion of a split skin graft over a stent which is formed according to the demands of the occasion. The skin graft is inserted anterior to the stricture. The posterior incision for location of the urethra is closed. The stent must have a hole for an exit of the urine. After the stricture has been completely severed this will give a permanent functional result. This is a rather difficult procedure. One may have to close the entrance posteriorly at a later date but in the case we are presenting it was closed at the time of the operation and it remained closed because the tube which was inserted into the skin graft at the anterior part of the penis allowed the urine to come out through it. We have not seen this method of preventing a stricture described before. We believe the method has a distinct usefulness in certain cases (case 12).

Immediate coverage should be the objective. Due to the general condition of the patient, the presence of infection or a long time interval between the receipt of the injury and the opportunity for therapy, the ideal treatment cannot always be obtained. In such cases it is necessary to obtain a satisfactory granulating base which may be accomplished by the application of wet dressings saturated with saline or boric acid. Before applying a skin graft to a granulating penis the same principles are used for preparation as are used on other wide granulating areas of the body. The granulating surface must be thoroughly prepared to accept the skin graft. In certain cases it might be wise to insert the penis beneath a pubic skin flap. This allows it to become clean and holds it in its outstanding position so that when the penis is uncovered one has a clean field upon which to apply the skin graft which will make the percentage of good takes run a much higher avarage. As stated, we think it well when the testicles are uncovered to insert them beneath the skin of the inner thigh. This holds them in position, allows them to maintain the blood supply and prevents infection and the development of contracting scars. At this time, the use of penicillin as well as the local application of tyrothricin should aid in cleansing the urine and preventing the spread of local infection.

If the urethra is not involved, catheter drainage with a Foley catheter may be sufficient: When one is trying to build a new urethra, however, we believe posterior urethral drainage is of great value as it prevents the urine from involving the anterior sutured defect. As to the matter of dressing after the operation, we believe that the penis should be turned over the pubic region. A suture is placed through the glans and the glans is sutured to the abdominal skin. After this a pressure dressing of the type used for split skin grafts on freshly denuded areas in other regions is applied. We usually use a large marine sponge both laterally and above the anteriorly fixed penis, utilizing a very tight gauze roll applied as a spica dressing. When these sponges become dry they act as a cast, movement of the penis is prevented, and priaprism can hardly occur as there is no room for expansion of the penis. Whether sedation with barbiturates, bromides, or chloral hydrate is of great benefit is questionable. But they should be put into practice if priaprism is troublesome. We note that recently stilbesterol has been given with good results.

A general list of cases seen may be briefly tabulated:

(1) A two year old boy, a patient referred later to Blair (1923) had bad a circumcision. A rubber band placed about the base of the penis to prevent bemorrhage was not removed following tbe operation. The result was a complete total slough of the penis.

(2) In about 1928 a patient was seen in consultation who complained of the glans penis being so tender that it was impossible for bim to walk without his clotbing causing unbearable pain to the glans. Previously, he had had a circumcision whicb uncovered the glans. Because of some complications which did not concern the operation, he was sent to Dr. Blair who lowered the skin of tbe penis over tbe glans and placed a circumferential skin graft on the denuded area about the upper part of the penis. After the operation Dr. Blair sent us photographs and reported tbat the man had obtained a good functional result.

(3) At the University of Kansas Hospitals tbis past year, a five year old boy was seen in the emergency room for laceration at the base of the penis. Several hours prior to admission he had tied a string around his penis attaching tbe other end of the string to the bed post. He then fell out of bed. Tbe skin was removed from his penis save the attachment at the glans. Dr. Stephenson resutured the skin. The result was good (fig. 1).

(4) A 23 year old soldier was wounded December 1, 1944 by shell fragments, (D. W. R.) suffering a penetrating wound of both anterior thighs and the penis, partially severing the glans from the sbaft. Both corpora cavernosa were cut through and the glans was banging only by tbe intact urethra and partially severed corpus spongiosum urethrae. The skin of the distal half of the shaft was severely lacerated and detached from two-thirds of the circumference but was viable. Eight hours after injury under ether anaesthetic, debridement of the wounds was carried out. The penis was cleansed, clots removed, and the thrombosed nonviable ends of the corpora cavernosa trimmed back to active bleeding. Tbe loose skin of the shaft was trimmed of its dirty margins which were sutured, employing some shifting to effect complete closure. The glans was sutured to the corpora cavernosa with 00 plain catgut employing mattress hemostatic sutures. The wound was dressed with vaseline gauze pressure dressings. A catheter was not inserted. The soldier voided well from the first few hours and, surprisingly, the skin and glans were entirely viable and of good color and appearance at the first dressing. On the fifth postoperative day he was evacuated in good general condition.

(5) A 30 year old soldier on April 28, 1945 suffered a penetrating wound from a shell fragment entering the left upper inner thigh at the perineal juncture (D. W. R). The left common femoral artery was lacerated producing a large hematoma in the upper thigh but no active bleeding when first seen. There was a severe laceration of the penis at the mid shaft

with complete severance of the left corpus cavernosum and a partial laceration of the corpus spongiosum urethrae but the urethral mucosa was intact. An operation was performed under ether. Twenty-four hours after injury debridement of the wounds was carried out. A primary anastomosis of the lacerated common femoral artery was performed using 0000 black silk, a solution of heparin and saline flushing out the arterial ends before suturing. The corpus cavernosum and spongiosum were sutured with plain 00 catgut, a catheter being in place in the urethra during the repair. Postoperatively the patient did well. Although weak at first, posterior tibial pulsations were felt full and strong by the fourth day. The penile repair was in good condition and the soldier was evacuated May 3.

(6) In 1936 a man came in who had had the skin removed from his penis and a part of his scrotum. A surgeon previously had implanted the penis beneath a pubic skin flap The

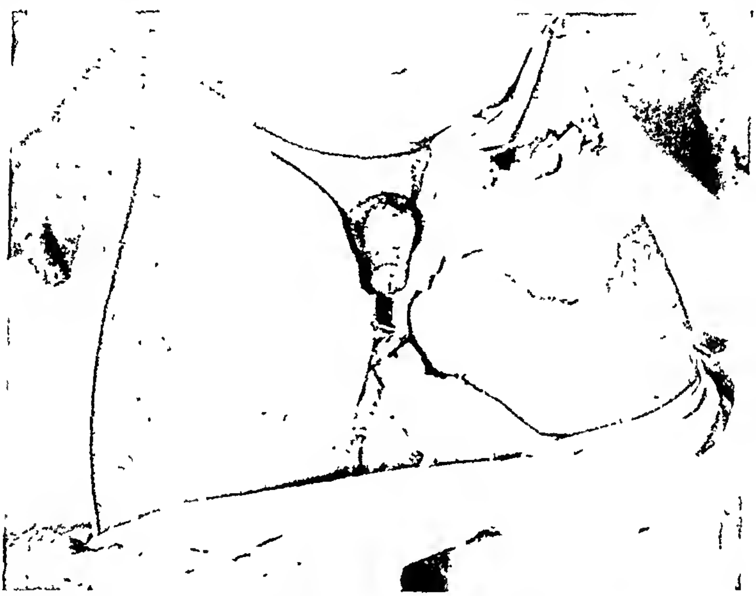


Fig. 1. The suture line of the laceration around the base of the penis following the injudicious tying of a string

There is very little tissue loss here (Case 3).

penis protruded upward and had circumferential dimensions of astounding and unusual magnitude. The problem was to get a penis of reasonable size with dependent protrusion. Most of the pubic flap was removed to get rid of the thickness. By the use of a thin scrotal flap the penis was recovered. Erection was normal. A year later the man became a father. Some hair remained on the penis I wanted to remove it with an electric current as he had little sensation in the flap at first He demurred, however, stating that the result was good enough for all practical purposes (fig. 2 a, b, c, d)

(7) In 1917 in World War I (E C P.) a Lieutenant in the Medical Corps was sitting having a bowel movement when a piece of shrapnel blew off his penis As he had been married only three days before going overseas his mental state was disturbed. He began to take morphine and finally disappeared. Frumkin's procedure possibly would have been of value for this medical officer

(8) A soldier in World War I (E C P) had a shrapnel wound which opened his buttocks

FIG. 2. (a) The large scar across the lower abdominal wall demonstrates the donor site of the large pedicle flap seen wrapped around the shaft of the penis. The patient came to us like this the flap operation having been performed elsewhere. (b) Holding up the penis in full extension demonstrates the great bulk of the flap on the ventral surface. (c) The final reshaping and cutting down of the abdominal pedicle graft gives a much better result. (d) Lateral view shows a fairly even distribution of the pedicle graft. (Case 6).

and rectum and removed the left one-half of his penis but glans was preserved. He was placed in a water bath to clean off his buttocks and rectal wounds. No operation was done on his penis. If seen at present we believe he would be an example of a case which should have a skin flap applied to the lateral side of the penis after closure of the urethral opening.

Finally a cartilage implant should prevent some lateral deviation. At that time such suggestions did not occur to the surgeons who attended him who were of the best

(9) In October 1944 a 35 year old man came into St. Luke's Hospital with avulsion of the skin of the entire length of the shaft of the penis except for the inner surface of the prepuce and the covering of the glans. Immediately Dr. Gaskins sutured the remaining ventral penile skin to the margin of the defect of the scrotum and pubic region. Later he developed a chordee on erection. To correct the chordee Dr. Padgett removed a fairly large sliding flap from the scrotum and after correcting the tendency to chordee the flap was applied to the ventral penis. The functional result was comparatively normal (fig. 3 a, b).

(10) In 1928 a 42 year old man entered the University of Kansas Hospitals with a severe slough of the scrotum and the lower abdominal wall. He had been affected with pediculosis pubis and in a moment of devotion his wife applied a lysol pack to his scrotum and pubic region. The pack was allowed to dry. The carbolic acid caused a slough of the total

Fig. 3. (a) The denuded edematous penis on admission. The intact inner surface of the prepuce is not shown in this photograph. (b) The final result of suturing the preputial inner portion to the lacerated margin at the penile base and later adding a scrotal flap reveals fairly adequate length. Function here although not quite perfect, is good and the tissues over the shaft are pliable. (Case 9).

scrotum and large areas over the inguinal region. He developed a streptococcic septicemia from which he recovered. After recovery his testicles could be seen protruding when the gauze dressing was removed. A flap from the thigh was applied to rebuild the scrotum and skin grafts were applied to the denuded inguinal areas (fig. 4 a, b, c, d). The functional result was good.

(11) This last year a man entered St. Mary's Hospital with a totally denuded penis and scrotum (Fig. 5 a, b). Dr. Gaskins who saw him first placed the penis beneath the pubic skin and each testicle into its respective thigh (fig. 6 a). Later Dr. Padgett outlined a skin flap on each thigh containing each previously implanted testicle. The flaps had an upper base with about one inch of the distal end not severed. Under local anaesthesia about ten days later the lower ends were severed (fig. 6b). The color of the skin flaps remained normal. About one week later both flaps including the testicles and vas deferens with its blood supply were inverted centrally and were sutured together with interrupted sutures to form an ordinary sized scrotum (fig 6 c). A rubber dam drain was placed posteriorly. The whole of the penis was removed from the pubic region and was covered with a thick skin graft. Through the penis a Foley catheter was inserted. The penis was laid on the abdomen with the spica pressure dressing which is described elsewhere. Over the areas from

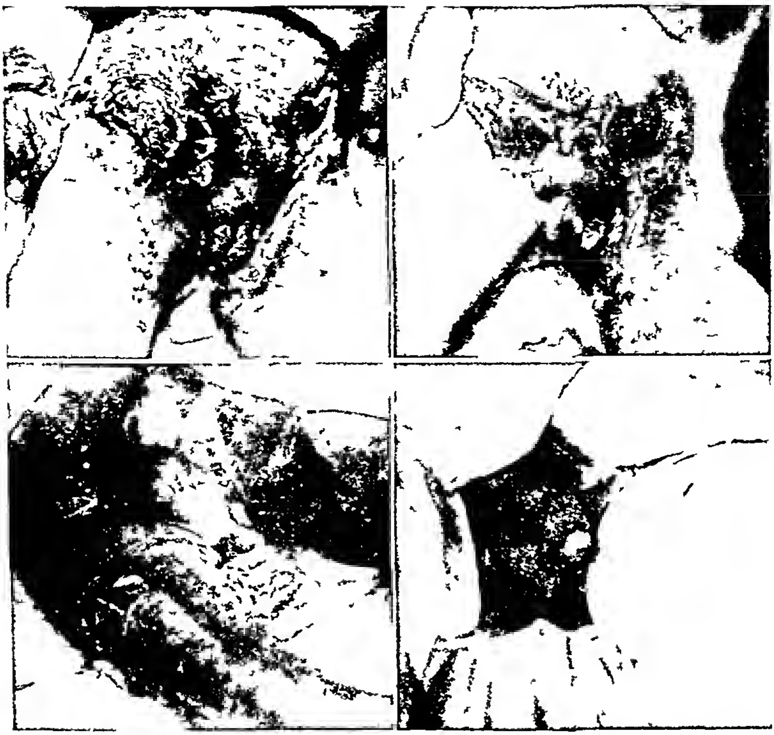


FIG 4 (a) The sloughs from the infection over the abdominal wall, both inguinal regions, left upper inner thigh, and anterior scrotum are separating following the severe infection, leaving a dirty gray granulating base (b) The sloughs are completed with fairly red, firm granulations ready for the reception of grafts The testicles are partially bared (c) Split skin grafts from the right anterior thigh have taken well on the abdominal wall and both groins The pedicle graft from the right upper inner thigh covering the anterior scrotal skin defect is healing in place and nearly ready for sectioning (d) The scrotum has been recovered anteriorly and the pedicle graft from the thigh cut and sutured to the lateral scrotal margin (Case 10)

FIG 5 (a) A frontal view of the dorsum shows the complete penile denudation to the corona The tunica vaginalis of the testes are bare, there being no scrotal skin left (b) With the penis extended, the full extent of the trauma is better demonstrated (Case 11)

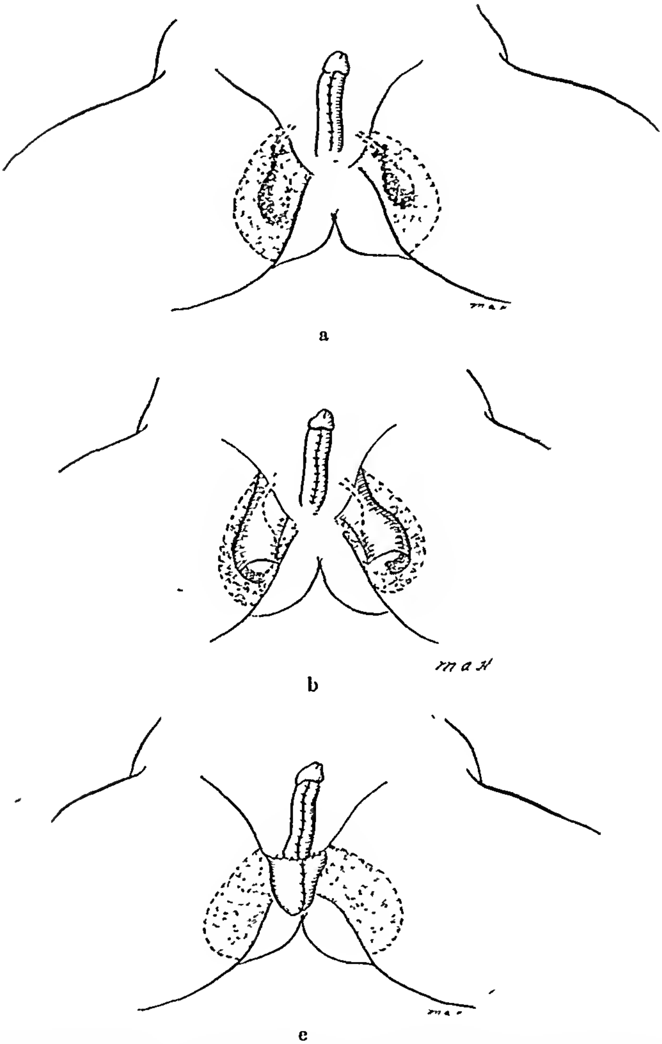


FIG. 6. (a) The diagnosis of the initial operative procedure for rebuilding the scrotum demonstrates the implantation of the testes in thigh pockets. The shaded areas indicate the size of the flaps to be elevated later. (b) The thigh flaps containing attached testes and adnexa have been elevated and cut loose at the lower end with the upper end the attached base. (c) The thigh flaps are further rotated medially and sutured together in the mid-line making a new scrotal sac containing the testes. The shaded areas here represent the donor site which had been covered by split grafts from elsewhere. (Case 11).

which the skin flaps were removed thick skin was applied. The "take" of the skin grafts described was total. Later he developed a small hole in his urethra at the scrotal base of the penis and he complained of a feeling of tightness in erection. Therefore, in one stage,

51036

a tunnel stent graft to four areas was applied (Dr. Gaskins) about the penis to give it more skin circumference. This was successful. Later Dr. Robinson successfully closed the small hole in the urethra. He used a posterior urethrotomy to divert the urine and also repaired the fistula over a catheter. To us this case represents the best and most successful manner in which a total denudation of penile and scrotal skin can be replaced (fig. 7 a, b). In this case the urethra also had a small opening.

(12) In 1939 a 30 year old man was admitted to St. Luke's Hospital complaining of difficulty in voiding for many years. Numerous dilatations and a circumcision had been performed to no avail. There was a stricture of the distal end of the anterior urethra. At operation the narrowed urethra was opened from the meatus and a skin graft cut by the dermatome and wrapped around a catheter was placed through the opening. A perineal opening of the urethra was made during the procedure to facilitate the accurate placement of the stent graft but closed at the end of the operation. Urine then passed through the catheter. We believe that this method of correcting a urethral stricture should be utilized more often.

FIG. 7. (a) The rebuilt scrotum is quite adequate and is of nearly normal appearance. The skin covering the shaft is pliable and non-constricting in erection. (b) With scrotum held up the donor sites of the pedicle grafts from the upper inner thigs are demonstrated. Split skin grafts from the abdomen cover the donor sites. (Case 11).

SUMMARY

For minor loss of the skin of the penis a flap from the scrotum is often the most applicable procedure as the scrotal flap is thin and has only the disadvantage of containing hair which can be removed. For large and complete loss of the skin of the penis split skin grafts properly applied and in sufficient quantity will give the most satisfactory result as the skin is thin, can be made large enough to allow expansion of the penis, and contains no hair. In these cases the functional result is good and in one case at least we have records that the patient had a child after the operation.

In reconstruction of loss of the scrotum, skin flaps from the thigh are most applicable and the cosmetic and functional result is good. In rebuilding a penis, a cartilage graft as described may be of value.

When the urethra is damaged the same principles are applicable as in the repair of a hypospadias and when part of the corpora have been destroyed a skin flap with some thickness is valuable.

A perineal urethrotomy for diversion of the urine should be done when the urethra is repaired.

When there is a large stricture of the urethra there is nothing that will correct it except re-covering the internal urethra with a skin graft. Small strictures may be controlled by periodic dilatations.

Anterior fixation of the penis to the abdominal wall with sponge dressings until healing of the sutured areas is complete is advantageous in preventing movement and priaprism.

BIBLIOGRAPHY

Benedict, S.: Scrotal skin grafts in severe injuries of the penis. Sou. M. J., **11:** 438, 1918.
Brown, J. B.: Restoration of the entire skin of the penis. Surg., Gyn. & Obst., **65:** 362 (Sept.) 1937.
Byars, L. T.: Avulsion of scrotum and skin of penis. Technique of delayed and immediate repair (using skin grafts). Surg., Gyn. & Obst., **77:** 326 (Dec.) 1943.
Cottle, G. F.: Avulsion of scrotum, left testicle and sheath of penis. U. S. Nav. M. Bull., **20:** 457, 1924.
Counseller, V. S., and Palmer, B. M.: Avulsion of skin of penis and scrotum. S. Clin. North America, **9:** 993, 1929.
Eric, W.: Two unusual penile injuries. J. Urol., **21:** 239 (Feb.) 1929.
Frumkin, A. P.: Reconstruction of the male genitalia. Amer. Review of Soviet Medicine, October, 1944.
Judd, W. S., and Havens, F. Z.: Traumatic avulsion of skin of penis and scrotum. Am. J. Surg., **60:** 246 (Nov.) 1943.
Kearns, W. M.: Testicular transplantation. Ann. Surg., **114:** 886 (Nov.) 1941.
Lewis, Dean: Practice of Surgery. Hagerstown, Md., W. F. Prior Co., 1943, 9: Chap. 30, p. 16.
Moore, C. R.: Physiology of the testis. J. A. M. A., **116:** 1638 (April 12), 1941.
Owens, N.: Reconstruction for traumatic denudation of the penis and scrotum. Surg., **12:** 88 (July) 1942.
Robertson, J. F.: Avulsion and reconstruction of scrotum and penis. Sou. Med. and Surg., **93:** 527, 1931.
Roth, R. B., and Warren, K. W.: Traumatic avulsion of the skin of the penis and scrotum. J. Urol., **52:** 162 (Aug.) 1944.
Sprout, S. M.: An unusual external injury. California and West. Med., **23:** 1318 (Oct.) 1925.
Sutton, L. E.: Reconstruction following complete avulsion of the skin of the penis and scrotum. New York State M. J., **43:** 2279 (Dec.) 1943.
Vernon, H., and Kelley, R.: An unusual surgical emergency. Brit. M. J., **1:** 925 (May) 1935.
Veseen, L. L., and O'Neill, C. E.: Plastic operation on penis. J. Urol., **30:** 375 (Sept.) 1933.
Westbrook, R. W.: Complete avulsion of integument of scrotum and penis. Long Island M. J., **5:** 405, 1911.
Whelan, E. P.: Repair of an avulsed scrotum. Surg. Gyn. & Obst., **78:** 649 (June) 1944.

THE CLOSURE OF SKULL DEFECTS

RUDOLPH JAEGER, M.D.

From the Department of Neurological Surgery, Jefferson Medical College & Hospital, Philadelphia, Pa.

Cranioplasty, like surgery on the brain, has lagged far behind the reconstruction of other parts of the head. There still remains some of the old superstition, even among medical men, that to operate upon or even touch the brain is dangerous. Practically the only real hazard to operations on the brain is hemorrhage, and gradually the neurosurgeon has developed a technique to cope with this problem that assures safety to the patient at the present time that is comparable to that of any other type of surgery. The problems of shock, anesthesia and sepsis are with the surgeon always, but they are sufficiently well understood now to assure the patient of a safe and painless procedure, even though the brain itself may be attached to a scar in the scalp.

Because skull deformity is so often associated with brain disorders by the layman, any conspicuous defect in the scalp at once advertises to all who may see that the person afflicted probably is "not all at home." The average person is as sensitive about the appearance of the scalp as he is about his face, or perhaps even more so. Why then should a person go through life with an unsightly depressed scar in the skull?

CAUSES OF SKULL DEFECTS

The causes of defects in the cranium are trauma, neoplasm, infection, and congenital malformation. Trauma in both civilian and military surgical practices is by far the most common reason for the loss of skull substance. It is a good surgical principle to discard all soft and bony tissues deprived of their circulation in the debridement of a compound or grossly contaminated wound of the head, except in rare instances where critical skin tissue such as parts of a nose, eyelid or ear must be saved for cosmetic purposes; even at the possible risk of grave infection of deeper parts. When the calvarium has been fractured it is not permissible to violate this principle in debriding a wound. Abscess of the brain, brain hernia, meningitis, osteomyelitis and death are too frequently the penalties for neglecting this simple primary rule in the immediate care of head wounds.

Benign neoplasms, usually meningiomas and osteomas, involve the full thickness of the skull and a large defect must be created to effect a cure. The skull defect necessarily remaining can sometimes be repaired immediately, but often the closure is more satisfactorily done at a second operation when the cranioplasty can be more thoroughly planned and at a time of election when the patient's general condition is most favorable.

Osteomyelitis of the skull must be cured by radical removal of the full thickness of the skull. Cranioplasty should be attempted in these cases only months after it is certain that the infection has completely died out.

Congenital defection of closure occurs in all parts of the skull but most often in the midline at the occiput. These defects are frequently associated with cranial meningocele, encephalocele, and other congenital deformities. Closure of the defect is never attempted at the time of removing the protruding mass if the patient is less than two years of age. Most of these defects are small and will close by themselves.

WHY SKULL DEFECTS SHOULD BE REPAIRED

Generally speaking, all skull defects should be repaired if they are unsightly, if they are large enough to pulsate, or if the patient worries about them. Occasionally resection of a scalp scar is necessary when it is painful but this is irrespective of whether or not an underlying skull defect exists.

Cranioplasty of small defects can be done under local anesthesia without great risk so there is seldom a good reason for not repairing cranial depressions. The large ones must be repaired to prevent the unphysiological pulsations of the brain. There would seem to be no valid reason for not repairing any cranial defect that a patient is concerned enough about to consult a physician.

MATERIALS USED FOR SKULL CLOSURE

It is useless to go into a detailed discussion of all the various materials that have been used in the closure of skull openings. Silver, aluminum, gold, animal bone, preserved cadaver bone, preserved cartilage, autogenous cartilage, celluloid, vitallium, plastic materials, heterogenous human bone, autogenous bone with or without periosteum, stainless steel (figs. 1 and 2), and lastly, tantalum have been used extensively. Silver, aluminum and gold tarnish, oxidize or corrode in the body tissues and become irritating with a tendency to be cast off. Preserved animal or human bone, decalcified human bone or preserved cartilage become absorbed leaving only scar tissue which is insufficiently strong to preserve the contour of the skull. Celluloid and plastic materials are well tolerated by the tissues and are structurally strong but they are difficult to cut, shape and adjust to the defect. Gurdjian and Brown (1) have described the technique for using "plexiglass" (methyl metha-crylate) in closing large skull defects. Vitallium has the same objection as celluloid and must be moulded to fit the opening perfectly, which usually requires an operation to form the mold and a second one for securing the metallic plate in place. Geib (2) has described the method for using this material.

Autogenous bone with its periosteum, stainless steel and tantulum are the materials best suited to fill large defects, while fresh living autogenous cartilage is more easily and perfectly shaped for locations requiring small pieces accurately carved for perfect cosmetic results, as around the forehead.

There are certain well known facts concerning the burying of material in the living human body that must be recognized by any surgeon attempting to perform cranioplasty:

1. All insoluble, nonirriting materials (vitallium, stainless steel, tantalum,

FIG. 1. TRAUMATIC SKULL DEFECT CLOSED WITH A PERFORATED STAINLESS STEEL PLATE
Craniotomy was performed to resect brain scar. Patient followed for six years and has had no trouble or signs of irritation from the metal

a b

FIG. 2. (a) Dots outline huge hyperostosis overlying intracranial meningioma which had to be sacrificed. [illegible] (b) Meningioma being removed resecting superior [illegible] stainless steel plate prepared before operation being inserted in skull defect. It rests on a shelf and is secured with wires. (d) Skin sutured over the stainless steel plate. (e) Steel plate in roentgenogram of skull. (f) Appearance of head after stainless steel plate has solidly healed in place.

plastic and celluloid plates) are encapsulated by the body fibrous tissues and may irritate and work their way to the surface if sharp points or edges press against soft tissues.

FIG 2c

FIG 2d

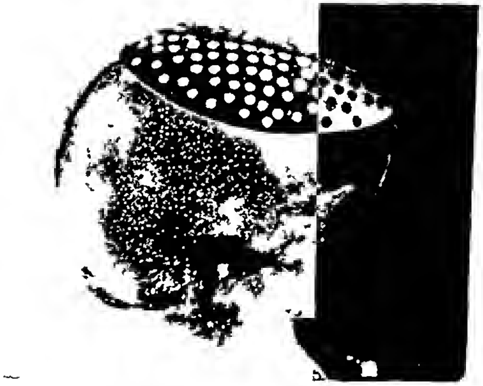


FIG 2e

2. Soluble materials which contain no lining periosteal or osteoblastic cells (boiled bones, bone treated with alcohol, formalin or other chemicals, animal bone, and chemically treated or dead cartilage) will be encapsulated and absorbed.

3. Bone transplanted in the same patient will live and grow if the periosteum or periosteal cells are transplanted with the graft or if periosteum covers the graft. The bone generating cells of the bone are kept alive by the serum in the wound, the same as skin transplants are nourished by the tissue against which it is applied.

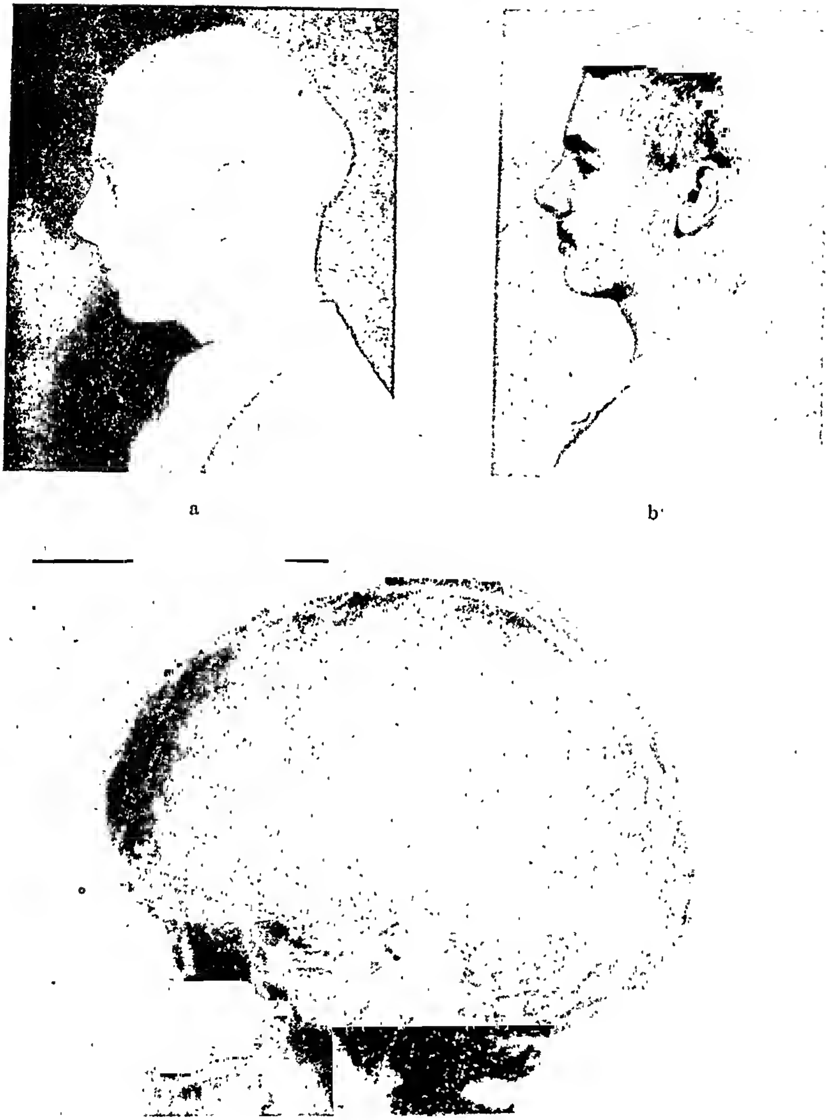
4. Fresh living cartilage has the power of staying alive in the patient the same as skin and bone and does not require the covering with a surface membrane like periosteum.

5. Infection and gross blood clot will cause the death of living cartilage and bone and prevent the sterile encapsulation of nonabsorbable materials.

Fig. 2f

AUTOGENOUS BONE

Fresh bone (fig. 3) with its periosteum from the patient's tibia is probably the most satisfactory material with which to close a skull defect, provided the opening is not too large or complicated in shape. Bone from the same individual completely fulfills the requirements of being always available, sterile and able to regenerate sufficiently to furnish a solid protective plate. Furthermore, it can be trusted never to irritate or become infected and the older it gets the less likely it is to become loose or to be sequestrated. All other materials are in constant danger of becoming inflamed from blood borne organisms, throughout the patient's life. No metallic material has yet been discovered that is absolutely free from gradual chemical decomposition by the action of air or tissue fluids. Moreover slightly projecting metallic parts are sure to irritate the overlying skin while bony points tend to round off and absorb, and depressions will fill in to conform to the configuration of the skull. Again, the mental attitude of the patient towards foreign material must be taken into consideration. Many



a b c

Fig. 3. (a) Osteoma of occiput before operation. (b) After removal of osteoma and immediate cranioplasty by tibial grafts. (c) Roentgenogram of osteoma of occipital bone. (d) Immediate appearance of tibial grafts held in place by stainless steel wires. (e) Eight month s after operation the defect is smooth, soild and entirely covered with bone.

persons develop a marked psychoneurosis towards anything other than their own bone implanted in their heads. This is particularly true in young persons and those with a neurotic disposition. Older individuals are more stable mentally, therefore far less likely to develop mental antipathy to substances not of themselves.

Bone from the outer table of the skull is necessarily thin and not sturdy enough to scaffold across the usual depression. When removed with a chisel the thin bone chips tend to curl up at the edges with the periosteum on their concave surfaces. This may make little difference and such a chip with the periosteum turned intracranially may be satisfactorily used to close defects less than $1\frac{1}{2}$ inches in diameter.

FIG. 3d

FIG 3e

Ribs are rather narrow and several widths are required to fill the usual defect. Again the curves in ribs in two directions make them difficult to fit and hold in place. Then, the chest wound is painful and a pneumothorax is more likely than not to be a complication in their removal. Bone from the ilium is not very accessible and it is difficult to shape.

The anterior surface of the tibia is wide, long and flat and is readily accessible without unduly complicating the sterile set-up. If necessary, both tibiae may be used and sufficient bone can be obtained to fill almost any defect

Scrupulous cleanliness must be maintained in bone grafting. The scalp must be shaved and cleaned thoroughly. Both legs are likewise prepared from the middle of the thigh to the toes. The skin overlying the skull defect must have softened up and thickened, so the circulation in it will be good when the grafts are covered. If the defect is not filled immediately after the injury or during the

first week or two following, it is better to wait at least four months before doing the repair. If scars are present which are adherent to the dura and brain with a very thin layer of skin, it is better to do a preliminary skin and scar resection several months prior to the cranioplasty. Either excise the thin skin and scar completely, pulling the thick healthy edges together or slide the skin together after excising the scar, from a spot well away from the defect. It may even be necessary to perform a skin graft to cover the skin defect left by moving the skin flap to cover the scarred area. It is imperative that there be healthy skin over any cranioplasty and time is required for the skin to heal and soften and the underlying dura to regenerate where it has been punctured. It is amazing how nature will gradually form a thick fibrotic dura from which the skin can be easily separated. It is best to prepare the skull defect site before removing the tibial grafts. Utilize, if possible, the old scar and improve its appearance. In reflecting the skin, always allow plenty of margin beyond the skull defect edge, at least $\frac{3}{4}$ inch, and keep the scar within the hair bearing part of the scalp when possible. If the skin is thin over the center it is best not to run the incision through this thin area but to use a new incision well to one side of the center of the scar. Subcutaneous infiltration with normal salt or novocaine solution may make the layers more distinct and the dissection easier between the skin and dura. Cut the periosteum at the very edge of the bone defect and reflect it away from the opening about $\frac{1}{2}$ inch with a chisel. This will also permit the dura to be stripped the same distance from the under side of the skull. The bone edges should be smoothed and freshened with rongeurs.

The next step is to make a pattern from the now prepared opening. A piece of x-ray film from which the emulsion has been removed makes an excellent pattern. It is laid over the opening and the bone edge can be seen through it. A marking fluid (commonly used is carbogentian violet) with a cotton tipped applicator or toothpick marks the outline of the opening. The pattern can then be cut with scissors.

The skin over the tibia is next incised down the middle of its flat side to the periosteum which is left in place. The periosteum is marked around the edge of the pattern with a knife. If the hole to be filled is large, it may take two or even three strips from the tibia. The cutting of the tibial grafts requires the use of a bone saw. For this purpose the Lucke circular saw is satisfactory. It can be sterilized in its entirety in an autoclave; it is light and easily handled. The grafts are kept in warm Ringer's solution until they are used. They are shaped to fit the skull opening by biting the edges with a rongeur or by sawing with the circular saw. It is unnecessary to lay the grafts on a beveled shelf of the skull edge. They can be held in place flush with the skull by means of stainless steel wires passed through several holes in the graft and skull edge, made with the Lucke electric bone drills which fit into the electric saw motor. The galea is sutured with silk or fine chromic gut and the skin with silk. A Penrose drain should be used for 24 hours to permit blood to drain from the wound. Fluid may collect beneath the skin for a week or two following operation in which event it should be aspirated through a large needle.

The closure of bone defects by autogenous tibial bone grafts has been used on

my neurosurgical services in 49 instances. There was not a single wound complication in the entire series, except in one patient who developed a thrombophlebitis of the femoral vein as a result of the surgery on the tibia. All have had complete closure of the defect with a good cosmetic result.

METALLIC PLATES

Both stainless steel and tantalum are entirely satisfactory for closing skull defects (3, 4, 5). Neither will corrode, tarnish or irritate the body tissues. Both will slough through the skin if a sharp point or edge presses against it. Stainless steel is tougher and more rigid than tantalum and is more difficult to shape. Once shaped and properly placed it is sturdier protection than tantalum. Scott and Wycis (6) have recently described the reaction of the tissues to this metal, and the author reported its use for closing a large skull defect some years ago (7). Tantalum is much easier to cut with tin shears but difficult to bore holes through and polish because of its softness. Tantalum lends itself to being moulded because of its malleability and it can be made to fit into irregular depressions more readily than steel. This method of moulding tantalum plates has been described by Woodhall and Spurling (5).

The surgical technique in using stainless steel and tantalum is precisely the same for repairing most defects. Prior to the operation a plaster of paris form should be made of the defect and the surrounding skull so as to visualize the entire contour of the skull. Usually this requires the close removal of all the hair by an electric clipper or razor. The hair stubble is covered with vaseline and the head is encircled with a thick towel held in place with a tight band of adhesive. With the patient sitting erect or semierect the ordinary cast plaster is poured onto the top of the head about one inch thick. To accenuate the depresion in the defect area so as to more accurately determine the bone edge, it is permissible and advisable, where the indentation is not marked, to remove cerebrospinal fluid by spinal puncture. Thirty to 50 cc. of fluid may be removed without harm to the patient. When the mold has hardened the inside is smeared with vaseline and plaster is poured into it. This forms a true reproduction of the skull with the defect in it. The metal is now shaped to fit the plaster cast making slight allowance for the thickness of the skin overlying the edges. By using a "ball peen" hammer and pounding on the center of the metal it can be made to take on a convex shape that, with a little experience, will perfectly match the normal skull contour.

Metallic plates are placed over the defects in two ways. The first and simplest method is to make the plate about ½ inch larger than the hole to be filled, and after reflecting the periosteum this distance, the plate is simply placed on top of the skull and held in place with short screws. The screw holes can be prepared in the metal prior to the operation and the bone holes made with the bone drill. The second method is to make the plate about ¼ inch larger than the hole to be covered. With a sharp chisel, a shelf is made around the entire edge of the defect on which the plate rests. It can be held in place with wire of the same material as the plate.

In both methods some fitting of the plate by bending it and trimming is

possible. The lay-on method is faster but the last described technique is the better of the two. It is a good idea to bore many holes in the plate to permit tissue to grow through them and to lighten its weight. These also permit easier shaping of the plate to the opening and permits fluid which collects beneath to run out beneath the skin. It is usually necessary to remove this fluid by needle puncture a few times.

For the past seven years the author has repeatedly used stainless steel plates in repairing skull defects without once noting any sign of it causing irritation. I have used stainless steel for wiring the skull closed and for securing bone grafts and stainless steel plates in place in countless instances without noting the least irritation from it. On re-opening the skull where this wire has been used, the wire is invariably found bright and shining.

My experience with tantalum has been limited to one case where is was necessary to fill a defect too huge to be accurately filled with stainless steel or bone grafts. The experience of Woodhall and Spurling (5) with this material in 79 cases and only four postoperative wound complications indicates that it is physically fitted to be tolerated by the tissues and is satisfactory in military surgery. However this metal has not stood the test of time in civil practice.

SUMMARY

All skull defects that are unsightly, pulsating or in any way troublesome to the patient should be closed. The most desirable materials for covering skull openings is autogenic bone from the patient's tibia. Autogenic cartilage or cranial chips may be used if the defect is less than an inch in diameter. For rapid closure, as under war conditions or following time consuming preliminary procedures, tantalum or stainless steel plates are recommended. Huge defects must of necessity be closed with a metallic plate.

REFERENCES

1. Gurdjian, E. S., and Brown, J. C.: Impression techinc for reconstruction of large skull defects. Surgery, 14: 876 (Dec.) 1943.
2. Geib, F. W.: Vitallium skull plates. J.A.M.A., 117: 8 (July 5) 1941.
3. Fulcher, H. J.: Tantalum as a metallic implant to repair cranial defects; preliminary report. J.A.M.A., 121: 931 (March 20) 1943.
4. Gardner, W. J.: Closure of defects of the skull with tantalum. Surg., Gynec. and Obstet., 30: 303 (March) 1945.
5. Woodhall, B., and Spurling, R. G.: Tantalum cranioplasty for war wounds of the skull. Ann. of Surg., 121: 649 (May) 1945.
6. Scott, M., and Wycis, H.: Experimental observations on the use of stainless steel for cranioplasty; a comparison with tantalum. To be published in Journal of Neurosurgery.
7. Jaeger, J. R.: Stainless steel in surgery. Steel Horizons (published by Allegheny Ludlum Steel Corporation), 3: 17, 1941.

ELONGATION OF THE NASAL COLUMELLA

A New Operative Technique

CLAIRE LeROY STRAITH, M.D.

Detroit, Michigan

Since LeMonier first succeeded in closing a cleft palate in 1760, a great many of the world's foremost surgeons have devoted their talents to the improvement of cleft lip and palate defects. That results still leave much to be desired is a tribute to the difficulty of the problem. All modern methods of repair are a composite of the contributions of many men living and dead. No one method is applicable to all cases. No technique, no matter how small, should be overlooked, for each advance means for some patients a more pleasing appearance.

One of the common problems which plague the plastic surgeon is the flat ala and distorted nostril in single cleft lip surgery and the short columella with the flattened nasal tip seen in double cleft lips. The columella may be short actually or only apparently. We see a real shortening most typically in double cleft lips. Here the distance from tip to philtrum may be short out of all proportion to the size of the nose. This results in a marked flattening and broadening of the nose which is very disfiguring. In extreme cases the tip may be almost continous with the philtrum giving the nose a bifid appearance. The extreme is usually seen in new-borns and tends to be modified with growth.

In single cleft lips the usual nasal deformity is a dropped flattened ala with horizontal nostril on the cleft side. In these patients the columella is really short on the cleft side in association with the flattended nostril. One could produce this effect on a normal nose by splitting the columella and suturing one side at a lower level. Blair attacked this problem by removing a crescentic section from the tip just above the nostril. Others, notably Erickson, Gillies and T. P. Kilner have vertically incised the columella and avanced the affected side upward.

We also see individuals without clefts who have congenitally flattened noses associated with tiny nostrils. Here the ala skin comes down over the nasal tip and stretches across from ala to columella like a veil leaving a small round nostril below it. This is an apparent columella shortening. The distance from tip to philtrum is normal as is the nostril height if measured behind the veil.

In the past the short columella of double cleft lip has been repaired by shifting the philtrum upward. This is done by the immediate or delayed methods. In the immediate method the philtrum is dissected free, immediately raised and folded on itself to form the columella. The lip is then closed in the midline over the premaxilla. This produces an acceptable columella and a good height to the nasal tip, but at the following expense. The lip itself becomes narrow and long with a tight midline scar. This is undesirable because in these cases it is always better to err on the side of greater width of the lip rather than greater length. Also the midline scar is unnatural and an upper lip without a philtrum always

Fig 1

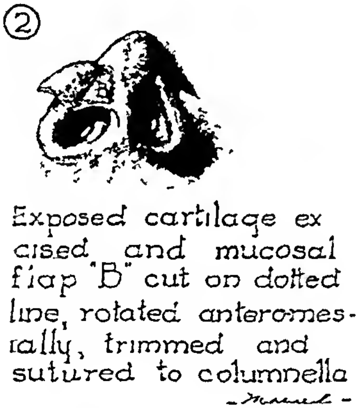


Fig 2

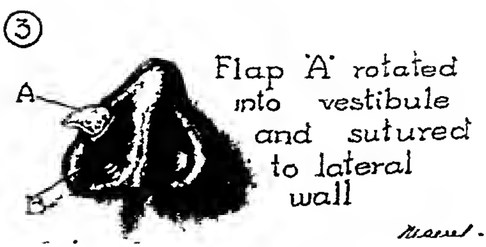


Fig 3

attracts attention. There are other objections In males a columella made from the philtrum may grow hair. Also it is difficult permanently to anchor such a columella to the lip.

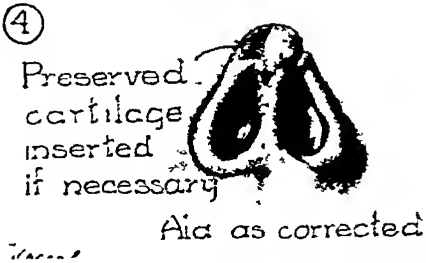


Fig 4

Fig 5

Fig 6

Fig 5 Typical Flattened Nostril and Nasal Tip Seen in Single Cleft lip Patients
Fig 6 The Lip Scar Has Been Excised, the Columella Elongated and the Nostril Lengthened by the Author's "Crossed Flap" Operation
Preserved cartilage was inserted to raise the left side of the nasal tip

In the delayed method the lip if first repaired after the manner of Federspiel. The philtrum is incorporated into the lip and no lateral skin flaps are brought under the philtrum. With growth the philtrum becomes quite large. After several years the central portion of the philtrum is dissected free, but left attached to the base of the columella and raised to lengthen the columella. This method is an advance over the immediate method in that, with growth, the philtrum is so

FIG. 7. As in all cleft lip plastics the lip flaps have been brought together with three figure of 8 nylon sutures, tied on the underside to relieve lip tension. The surface was brought together with a subcuticular nylon suture.

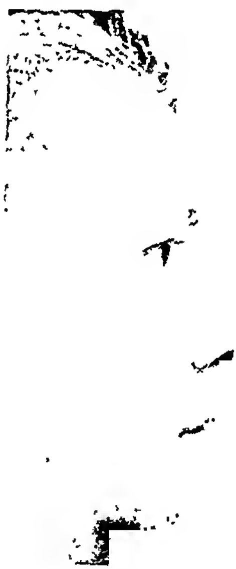


FIG. 8. PROFILE VIEW OF SAME PATIENT AFTER CARTILAGE IMPLANT TO THE NASAL TIP

Fig. 9. Post-Operative View

Note similar size nostrils and normal nasal tip elevation. The lip scar is but slightly visible

Fig 10. Typical Skin Web Overhanging Upper Half of Each Nostril as seen in the Double Cleft Lip Case and Congenital Flat Nasal Tip

This "crossed flap" operation on each side seems the best solution for this problem

large that all of it is not needed to form a columella. Many excellent repairs have been produced in this way.

FIG. 11. POST-OPERATIVE RESULT FOLLOWING DOUBLE "CROSSED FLAP" OPERATION IN A DOUBLE CLEFT LIP CASE
The lip plastic was done by the Federspiel method

FIG. 12. SIDE VIEW SHOWING THE ELONGATED NOSTRIL AND IMPROVED NASAL TIP IN THIS PATIENT FOLLOWING THE "CROSSED FLAP" OPERATION

The shape of the piece slid up from the lip varies with different operators. It usually takes the form of a "V" as illustrated years ago by Brophy. In 1941

Brown and McDowell described a philtrum flap called the fleur de lis. This adds a small flap taken from the nasal floor on each side of the "V".

For some years the writer has experimented with a procedure found to be useful in the correction of short columella real or apparent. It was noted that in many of these cases, while the columella was very short, the septum just a few millimeters back from the tip was of normal height. By doing a Z-plastic type of procedure on the ala margin and the tip at the upper angles of the nares, the nares are enlarged in their vertical diameters and the columella appears much longer.

TECHNIQUE

In single cleft lips a small vertical skin incision is made at the upper inner angle of the nostril. The incision should be slightly concave laterally similar to the curve in the normal nostril and to the same height. Another incision is made just inside the skin margin, across the upper part of the nostril from the ala to the columella and connects with the first incision. This outlines a small flap of skin attached to the ala which is dissected from the underlying cartilage (fig. 1). The exposed cartilage is then removed leaving the nasal lining. The lining is now incised along the alar attachment forming a flap of membrane attached to the septum (fig. 2). The flap of mucous membrane "B" is swung medialward, any excess is trimmed, after which it is sutured to the skin margin at the site of the original incision on the columella (fig. 3). The alar cartilage is properly trimmed. The skin flap is now turned into the nostril, trimmed and sutured to the lining of the ala with horsehair. If desired this procedure may be combined with the insertion of cartilage in the nasal tip to add to its height (fig. 4).

The removal of a skin wedge from the nasal floor to narrow the nostril and the advancement of the ala toward the columella often improves the appearance of the nostril (figs. 5–9).

COMMENT

In double cleft lips the operation is repeated on the other side. This procedure may be done in children or adults. It follows by a few years the Federspiel repair of the double cleft lip. In children, if the case is borderline, it is perhaps wiser to wait for further growth so that the extent of the Z-plasty can better be gauged. In suitable cases in adults it produces very pleasing results with a minimal amount of surgery that can easily be done under local anesthetic (figs. 10–12).

Some of the most pleasing results are obtained in the congenital flat nose with short columella. Here the Z-plastic done bilaterally lengthens the columella and gives the illusion of greater height to the tip.

We also see patients with noses which are essentially normal and symmetrical except for the nares which appear as two small round holes on each side of the base of the columella. The tip skin comes down as a veil on each side. In these cases the double Z-plastic enlarges the nares and exposes the full length of the columella with a minimum of surgical effort.

Recently it has been brought to the writers attention that Joseph had used a

similar operation in the final stages of total rhinoplasty. Faced with a heavy excess of flap at the nasal tip with inadequate nostrils, he employed what might be termed the mirror image of this procedure. He outlined a flap with its base on the columella and swung the tissue into the nostril. The other flaps are sutured along the edge of the ala. It occurs to the author that this might leave a rough irregular edge to the ala.

In conclusion the author feels that the Z-plastic procedure is useful both in correcting the distorted nose associated with the single cleft lip and in elongating short columella of double cleft lip and in other nasal deformities characterized by a short columella. It does not entirely replace other methods, nor is it applicable to all cases because no procedure is applicable to all cases, but in suitably selected individuals we believe it is a contribution.

EDITORIAL

It is with great satisfaction that we introduce PLASTIC AND RECONSTRUCTIVE SURGERY, the first journal to be devoted exclusively to the specialized fields indicated by its name.

The American Society of Plastic and Reconstructive Surgery was organized in 1931. The objects of the Society were and are, as stated in Article I Section 2 of its constitution:

"(a) To promote and further medical and surgical research pertaining to the study and treatment of congenital and acquired deformities.
(b) To keep the medical profession informed of the scientific progress in plastic and reconstructive surgery.
(c) To stress the great social, economic and psychologic importance of this surgical specialty."

The scientific progress in this specialized field of surgery has been so great, the world-wide interest has become so extensive that there has arisen a definite need for the type of journal which will further speed the realization of the above stated objects. Although this journal is sponsored by the American Society of Plastic, and Reconstructive Surgery, its Editorial Board wishes it to be definitely understood that the papers, case reports and other articles accepted for publication will not be limited in their authorship to the members of that organization.

Original meritorious papers on clinical studies, scientific observations on any phase of reconstructive surgery, reports on laboratory studies or other research work may be accepted for publication subject to approval by the editor, and two of the associate editors, selected by him because of their familiarity with the special subject being presented.

Publication will be bi-monthly, totaling one volume of at least five hundred pages per year. The first three numbers will be double ones so that Volume I may be completed in 1946. Thereafter the six numbers issued during each year will constitute the Annual Volume.

WARREN B. DAVIS

EDITORIAL

An International Abstract of the current plastic surgical literature will appear soon in each issue of our journal. A group of experienced plastic surgeons have been selected to present brief synopses of all articles dealing with plastic and reconstructive surgery published in other journals. Illustrations will be used when it is necessary to more clearly demonstrate important new procedures.

The abstracts are to include articles dealing with clinical and experimental work in tissue healing, wound infection, suture materials, shock, anesthesia, the management of operative complications and other subjects of importance to surgeons in all fields of work.

Our board of reviewers will cover foreign as well as domestic literature so that bound copies of the JOURNAL OF PLASTIC AND RECONSTRUCTIVE SURGERY will

contain all of the worthwhile plastic literature, cither in the form of original articles or as brief but accurate synopses of papers appearing in other journals.

LYNDON A. PEER

EDITORIAL

MILITARY PLASTIC SURGERY

The principles of plastic surgery and plastic surgeons themselves have contributed a great benefit and a tremendous amount of work for wounded soldiers and sailors in this War. The contribution has been by civilian plastic surgeons in the Army and by young surgeons trained in plastic surgery centers of the Army and Navy by these reserve officers. There does not seem to be enough recognition of this surgical specialty (or other specialties) to warrant a regular Army officer making a career of a specialty in the Service and this may be offered as an excuse for any accusation of apathy on the part of individual regular officers. This same lack of recognition goes down through many echelons of the Service whether headed by regular officers or not, and in this War the surgeon of a foreign theater (E.T.O.) was the first (and only) administrator to ask for a consultant service in this specialty run by officers in the Army. Centers were sct up and functioned individually in this country, but without central direction, until the end of the War. However, there existed, at the end of the War,—a natural tendency to reduction of services in general, and there was little to be done other than carry along with the tremendous load that existed in operative work.

One of the finest annals of surgical work in the entire War is the spirit and performance of the surgeons from civilian life in the plastic surgery centers. Huge services were developed up to 1800 patients and smooth operation was maintained on the simple and humble basis of the need of care for wounded soldiers. The soldiers themselves showed the finest spirit imaginable and made the remarkable recovery rate to useful life of close to 90%. The death rate in spite of the most formidable procedures was practically nil and in this record high tribute is due the anesthesia, medical and nursing services. Figures are not necessary as they are not completed so far, but one Service to date has done about 8,000 operations without a death and the nurses have done the major part of over 100,000 dressings.

Where these Services have been allowed to develop and to prove their worth, they have won full cooperation and great help from Commanding Officers and other echelons of administration.

Space does not permit an analysis of the work in the Services, but a brief summary of actual surgical progress that may be associated with the efforts cf plastic surgeons that has been widely used for wounded soldiers may be given:

(1) The substitution of gentle wound care for tannic acid treatment of burns.

(2) The use of fine mesh gauze next to wounds.

(3) The use of pressure dressings in burns and all other wounds by the use of mechanics cotton waste or other medium.

(4) Early grafting of burns.

(5) Early grafting of gunshot wounds.

(6) Early closure of wounds.

(7) Mass production of plastic surgery by civilians working in the Army, with an excellent record of results and with a death rate that is practically nil, and the amazing integrity and sincerity of purpose on the part of plastic surgeons doing the work.

(8) Development of young surgeons to take on details of plastic surgery in mass production.

(9) Widespread application of skin grafts to wounds by general and orthopedic surgeons as a definite contribution from the specialty of plastic surgeons.

(10) Close cooperation of plastic surgeons with dentists, orthopedic surgeons and neurological surgeons for best ultimate care of wounded soldiers.

(11) Extensive use of local tissue in repairs.

(12) Single or double stage procedures developed for repair of large palatal defects.

(13) Mass production of bone grafts to the jaw in numbers not equaled before.

(14) Use of cancellous bone from the ilium for reconstruction of the jaw, both upper and lower and about the orbit.

(15) Use of ribs for the same type of reconstruction.

(16) Development of cartilage banks for innumerable instances of contour restoration.

(17) The extensive use of cross leg or jump flap to the abdomen for the defects in the lower extremities, in innumerable instances avoiding amputation.

(18) Fundamental principle of closing wounds highly developed by plastic surgeons and used in a great number of instances as a preliminary to deeper orthopedic or neurological surgical operations.

(19) The concept that the deep healing can be no better than the surface healing has been a promulgated and established fact by plastic surgeons and accepted by all other branches.

(20) Use of full thickness skin grafts from clavicular region for color matching and function in repairs about the face.

(21) Use of composite free grafts of two surfaces of skin with cartilage in between from the ear, for nasal reconstruction.

(22) Rapid construction of ears by using local tissue, cartilage transplants, and free skin grafts, many times without necessity of any distant flaps or tubed flaps.

(23) The widespread acceptance of hand defect resurfacing work, with the ultimate saving of innumerable hands and return to useful life of the burned soldier.

(24) Development of extensive services to take care of extensive burns with many dramatic recoveries of extensively burned patients.

(25) Use of direct flaps for repair of deformities of the hand and arm, saving thousands of patient hospital days, so that the full length of the forearm can be

planted directly in the abdomen and the area totally restored in 14–20 days, using premise of a short broad flap rather than a long tubed one. This is one of the most significant mass contributions as far as saving time for the wounded soldiers and giving them the best result.

Those of us who have been privileged to take care of these wounded soldiers are deeply aware of our inability to provide for these patients as good results as they deserve and as we wish for them, but by study and analysis and trying to remember some essence of the Golden Rule, we can work and hope along with the patient that he may again find his way in life.

James Barrett Brown, M.D.

SURGICAL TREATMENT OF ICHTHYOSIS HYSTRIX

V. H KAZANJIAN, M.D

Boston, Mass

Ichthyosis hystrix is a giant nevus involving large areas of the body. The face, palms, and soles are occasionally normal It is characterized by hypertrophic, papillary elevations which are thick and vary greatly in diameter and length The microscope shows enormous papillary hypertrophy with a comparatively thin prickle layer of the skin

Sutton (1) describes the condition and shows a photograph of a fairly marked case in an adult This patient's children were also reported to have had the condition Davies (2) reports two cases in the same family McGlasson (3) reports two cases in children in the same family Therefore, there is probably some familial tendency in the etiology of this pathological condition.

SYMPTOMS

Ordinarily besides a dry skin the patient has no symptoms and the only problem is that of appearance. However, at times the lesion is situated in areas where it creates serious hygienic troubles because of the difficulty of keeping clean the deep folds of the skin In the axilla, groins, perineum, and about the genitalia it can be a source of great discomfort and embarrassment. The decomposition of bodily secretions deep in the folds gives rise to a foul odor

TREATMENT

In the more limited cases treatment by a dermatologist is indicated. Roentgen rays have been given up because effective doses are so high that serious sequelae may result. Electro-desiccation and surgery remain as the methods available for treatment.

Karfik (4) reported in 1934 that Dr F Burian with whom he worked in Praha used a method of treatment which has given good results in the cases to be reported in this paper. His method was to shave off the vegetations with a razor or a transplantation knife.

Case 1 (B B) This patient, a white American girl, twenty-one years old, was first seen at the dermatology clinic of the Massachusetts General Hospital, complaining of warty excrescences in the axilla, groins and elsewhere (figs 1, 2 and 3) These had been present since birth In warm weather the axilla and groins became tender, inflamed, and exuded an offensive odor when moist with perspiration Examination showed the skin of the upper part of the body to be generally thickened and dry The axillae, groins, and perineal regions presented warty masses of skin In the antecubital folds, the back of the neck, the upper abdomen, and in the upper half of the back the skin was thickened and had a brownish hue (fig 3) Running though the thickest patches streaks of normal skin could be seen, seemingly thinner than normal A biopsy showed papillomata, hyperkeratosis, and dermal changes which confirmed the diagnosis of nevus verrucosis or ichthyosis hystrix (fig 4)

At that time eight fractional doses of X ray (¼ S U at weekly intervals) were given to the axilla in an effort to reduce the hyperhidrosis

FIG. 1. PHOTOGRAPH OF LESION OF THE LEFT AXILLA, SHOWING DARK, THICKENED, WARTY MASS

Note the leathery appearance of the skin surrounding the mass. The right axilla presented the same picture

FIG. 2. PHOTOGRAPH OF THE GROINS AND PERINEAL REGION SHOWING THE SAME TYPE OF THICKENED WARTY GROWTH THAT WAS SEEN IN THE A[illegible]

FIG. 3. THE ENTIRE CHEST, BACK, AND BACK OF NECK WERE COVERED WITH A THICK, LEATHERY TYPE OF SKIN, BROWNISH IN COLOR

It seemed to be susceptible to treatment by shaving the epidermis

FIG. 4. THERE IS A MARKED DEGREE OF HYPERKERATOSIS WITH DEEP INVAGINATIONS OF THE HORNY LAYER

The epidermis shows irregular thickening. Some of the rete cones are greatly elongated and branch deeply into the corium. There is no inflammatory infiltrate in the corium. The changes of the epidermis are consistent with those seen in nevus verrucosis. The subcutaneous tissue appeared to have a normal appearance.

In June, 1936, the patient was seen in the plastic clinic and sent into the hospital.

Operation, June 6, 1936: gas oxygen-ether anesthesia. After a three day soap and water preparation of the field followed by a metaphen preparation, the papillomatous area in the right axilla was excised down to subcutaneous tissue which seemed to be unusually vascular. A rectangular flap was brought down from the upper arm to cover the defect. Silkworm gut and black silk interrupted sutures were used to close the incision, and two small drains were inserted under the flap (fig. 5).

Operation, June 27, 1936, under general anesthesia. The abnormal skin of the left axilla was excised down to the subcutaneous fat. The palm-sized defect was filled by sliding a flap from the inner arm and chest wall (fig. 5).

Operation, July 21, 1936, under general anesthesia. Ichthyotic skin below the left breast and on the anterior chest wall was shaved with an amputation knife creating a smooth surface with multiple bleeding points. A small ulcer present in the left axilla was closed at this time.

FIG. 5. POST-OPERATIVE APPEARANCE OF THE RIGHT AND LEFT AXILLAE
The treatment consisted of excision of the entire mass from the axilla and the covering of the raw areas with pedicled flaps from the surrounding tissue and skin grafts.

Operation, August 8, 1936, under general anesthesia. The ichthyotic skin of the right side of the vulva was excised with an equal amount from the upper aspect of the inner thigh. A relaxing incision was made distal to the defect on the inner surface of the thigh and the tissues extensively undermined. This created a bi-pedicled flap which could be slid upward to close the vulva and upper thigh defect. A split thickness graft from the right thigh was used to fill the defect created by the upward sliding of the flap just described.

Operation, August 27, 1936, under local anesthesia Two Thiersch grafts were removed from the lateral aspect of the left thigh to cover a defect still present in the right thigh.

Operation, December 13, 1937, under general anesthesia. The hypertrophic tissue was shaved off the left side of the vulva and the perineal region. In the groin crease it was necessary to excise a large elipse of skin and to close the wound with direct suturing.

The patient was then followed in the plastic clinic; and because there seemed to be some

recurrence in the left axilla and in certain areas of the perineum, the patient was again admitted to the hospital. She complained that she had a "stinging sensation" in her perineum when she walked and that she noticed irritation and bleeding of the ichthyotic tissue there.

Operation, November 13, 1939, under ether anesthesia. The areas below the left axilla, left and right antecubital spaces, and the right side of the perineum were shaved free of the hypertrophic tissue.

Operation, November 25, 1939, under ether anesthesia. The abnormal skin of the left side of the thigh was shaved away with a knife.

FIG. 6. APPEARANCE OF THE GROINS AND PERINEAL REGION AFTER TREATMENT WHICH CONSISTED OF SHAVING THE WARTY MASSES ON THE LEFT SIDE, AND ON THE RIGHT SIDE EXCISING THE LESIONS FOLLOWING WHICH A BIPEDICLED FLAP FROM THE GROIN AND SKIN GRAFTING WERE USED

She was followed in the plastic clinic and all of the areas healed completely (fig. 6). The patient was free of bad odor and inflammation and had no restriction of arm movements.

The patient was seen again on April 11, 1946. The right and left axillary folds showed no recurrence of lesions. Where shaving had been done there were scattered areas of papillary growth. Undoubtedly, these were the parts that I failed to shave completely. However, the patient was not having any discomfort.

Case 2 (R. M.). This patient, a white American boy, was first seen in 1943 when he was two and one half years old. He had a pigmented, papillomatous skin condition since birth. This was most marked on the neck but there were areas also present on the abdomen and back (fig. 7).

FIG. 7. APPEARANCE OF PATIENT WITH PIGMENTED, PAPILLOMATOUS SKIN CONDITIO[N]
The lesions were scattered around the neck, the right side of abdominal wall, and on the back

FIG 8 POST-OPERATIVE APPEARANCE OF THE NECK AFTER SHAVING THE LESIONS

Operation, March 7, 1944, under ether anesthesia The hypertrophic skin was shaved down on the neck, anteriorly, and on the sides and back

Operation, May 13, 1944, under ether anesthesia Using a sharp razor more of the

hypertrophic skin was shaved down, particularly on the neck and upper part of the chest. Where diathermy was used, later superficial ulcerations developed.

Operation, November 15, 1944, under ether anesthesia. Using a dermatome knife blade a large area on the right side of the abdomen was shaved away. With a safety razor another area on the neck was scraped. Since that time the patient has been considerably improved (fig. 8). He is still under treatment.

CONCLUSION

It will be noted that several methods were utilized in closing the defects created in the removal of the nevoid tissue. Pedicled flaps rotated into the defects, a bipedicled flap slid into a defect, direct approximation of the wound edges, and split thickness grafts were used with equal success. The second major method, that of deep shaving which removed much of the hypertrophic skin but left enough of the normal skin behind to heal the multiple bleeding points, did not create a raw area requiring skin grafting.

It is felt that the second method is fully as successful and is to be preferred because of its simplicity for most areas. However, in certain places, the use of pedicled flaps employing relatively normal skin is superior for it provides a more durable result.

REFERENCES

1. Sutton, R. L.: Diseases of the skin. 7th Edition. C. V. Mosby Co. St. Louis. 1928.
2. Davies: Lancet, London, 1: 713, 1920.
3. McGlasson: Texas State Journal Med., 17: 255, 1921-1922.
4. Karfik, V.: Traitement des naevi hypertrophiques étendus par abrasion. Revue de Chirurgie Plastique, 1: 33-37. 1934

DERMATAPE: A NEW METHOD FOR THE MANAGEMENT OF SPLIT SKIN GRAFTS

JOHN D. REESE, M.D.[1, 2]

Philadelphia, Pennsylvania

Within recent years there has been marked improvement in the results obtained in the field of reconstructive surgery. Many factors have contributed to this end, not the least of which is the improvement in technique for the excision of split skin grafts. This is attested by the fact that within a relatively short time there have appeared in the literature descriptions of several devices for the actual excision of the skin, as well as numerous suggestions for its management in transferring it to the recipient area.

In 1909 in the Halstead Clinic at Johns Hopkins, J. Staige Davis (1) placed a split skin graft that had been excised free hand upon a strip of gutta percha in order to counteract the natural tendency of the graft to contract and curl at the edges. Thus came the first suggestion for a sort of splint or backing for the split graft.

In 1939 Padgett (2) presented to the profession a mechanical device for the excision of large areas of split skin of controlled thickness. The Padgett dermatome is well known to the profession and need not be described in detail. Suffice it to say that it consists of a drum which is made to adhere to the skin of the donor area by means of a rubber cement, permitting the skin to be progressively lifted from its bed during the process of excision. The knife is so mounted as to permit rotation and reciprocation relative to the convex surface of the drum.

The modus operandi can be briefly summarized as follows: The drum of the dermatome and the skin of the donor area are coated with cement, the knife is set at the desired distance and the graft is cut directly upon the drum. At the termination of this step the graft is removed from the drum by traction applied to it with hemostats. While the excision of the skin is greatly facilitated by the use of the dermatome, the removal of the graft from the drum and subsequent management in transferring it to the recipient area is a procedure which requires some degree of skill for its successful accomplishment.

This is due to the fact that the bond between the skin, the two layers of cement, and the drum is usually broken at the surface of the drum, and some of the cement remains adherent to the free surface of the skin. Thus, during the removal of the skin from the drum and subsequent management, considerable care must be

[1] From the Plastic and Reconstructive Surgery Division of the Department of Surgery, Jefferson Medical College Hospital, Philadelphia, Pa.

[2] The author wishes to thank the Lee Tire and Rubber Company of Conshohocken, Pa., and particularly Mr. R. J. Limbert, for their technical assistance in developing and producing the Dermatape; also to express his appreciation to Dr. A. W. Angulo, Associate Professor of Anatomy, Hahnemann Medical College, Philadelphia, Pa. for his many helpful suggestions and criticisms throughout the experimental work and preparation of this manuscript.

exercised. The skin must be maintained under tension in all directions in order to prevent it from curling or folding, thereby becoming adherent to itself. Also, the traction necessary to free the skin from the drum necessitates some stretching of the graft with resultant trauma to its cellular structure.

In order to overcome this difficulty Webster (3) conceived the idea of interposing a splint of pliofilm between the drum and skin. The pliofilm was cemented directly to the drum and it in turn became cemented to the skin in the process of excision. The pliofilm and skin are removed from the drum as a single unit.

These improvements in procedure have greatly facilitated the management and transfer of the graft. Dr. Webster also found that under favorable conditions a graft so transferred need not be sutured to the recipient area, and in those cases where sutures are indicated they can be applied with greater ease than when the skin is transferred alone. More recently Berkow (4) has incorporated this thought into a specially designed tape which carries its own adhesive.

This presentation describes a new device, patterned after Dr. Webster's thought, which is applied to the drum mechanically instead of being cemented to it. We have called this device Dermatape (3) (Plate I).

Dermatape consists of a single layer of specially woven cloth and two kinds of rubber; one colored red and the other colored green. The cloth is first impregnated with the red rubber and then faced with the green, which is immediately covered with Holland cloth in order to prevent oxidation and preserve tackiness. The composition and processing of the red rubber controls the pliability of the Dermatape, and provides a smooth surface to minimize friction while it is being tightened to the drum of the dermatome. Its impregnation into the fabric provides the strength necessary to withstand tension when applying it to the drum, prevents stretching, and provides a dependable surface for the Elastikon or adhesive tape used in securing it to the recipient area. The green rubber is specially processed to accomplish two aims: first, to provide a dependable and positive cohesive agent for combination with the skin cement so that successful and satisfactory excision of the graft can be consistently accomplished; second, to slowly absorb the skin cement from the surface of the graft thereby neutralizing its own cohesiveness and freeing itself. This latter property facilitates its removal at the time of the first dressing.

Dermatape is manufactured in two sizes, one to accomodate a two and one-half inch dermatome, and one a four inch dermatome. Both the wide and narrow Dermatape provide for the excision of a graft eight inches long. The thickness of the Dermatape is thirty thousandths of an inch with a variation of plus or minus one-half thousandth of an inch. For all practical purposes, therefore, the Dermatape can be considered to be of uniform thickness.

By the combination of cloth and the two differently processed rubbers sufficient firmness has been given to the Dermatape so that it will neither stretch nor curl, with or without the graft, and at the same time remain pliable.

MODUS OPERANDI

1. A strip of Dermatape is sterilized by immersion in seventy per cent alcohol, then applied to the drum with the red surface adjacent to it. It is anchored and drawn tight mechanically, and the Holland cloth stripped from the green surface.

2. The donor area is prepared in the usual manner and then coated with a specially prepared cement. This cement is colored red in order that one can be sure that a continuous, uniform layer has been applied to the donor area. It dries in forty-five seconds and provides dependable adhesion to both skin and Dermatape irrespective of humidity and temperature of the environment.

3. The green surface of the Dermatape now covering the surface of the drum is firmly applied to the skin, previously coated with cement, and the graft is excised in the same manner as the Padgett procedure. The Dermatape is released and removed from the drum, and the procedure repeated until the desired area of skin has been acquired.

4. After removal from the drum the portion of Dermatape not covered by skin is trimmed, and the skin-bearing portion cut into strips or small squares and applied to the recipient area.

5. For areas that accept circumferential dressing such as the arms and legs, the skin and Dermatape as a unit is cut into strips about one and one-half inches wide.

6. Each strip is applied firmly to the recipient area, permitting it to overlap the edges of the lesion, and is secured in position by means of Elastikon. Repeated application of strips form a mould for the entire area (Plate II).

It is important that each strip follow the normal contour of the surface to which it is applied irrespective of whether or not voids of the lesions are allowed for the moment to remain ungrafted. These voids, and they are usually triangular in shape, can be covered later by small overlapping pieces and secured by additional strips of Elastikon.

7. After the application of the skin-bearing Dermatape to the lesion additional strips of elastic adehsive are applied to the entire area in order to provide maximum contact of the graft with its bed.

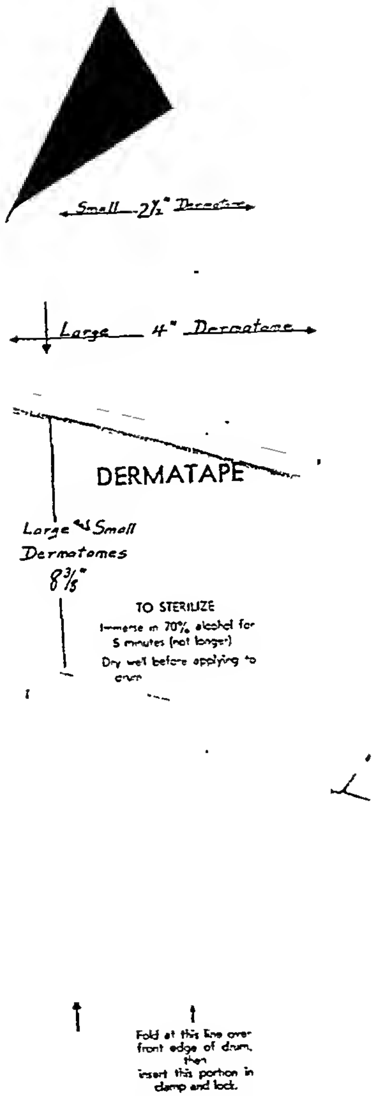
8. An absorbent dressing is then applied and this followed by immobilization of the part.

9. In areas of the body that do not lend themselves to circumferential dressing, such as the abdomen and thorax, the strips of skin-bearing Dermatape are cut into small squares and applied to the lesion according to the procedure of Hardy and McNichol (5) (Plate II). The grafted area is then dressed with either a bolus or bandage dressing according to the demands for immobilization.

If the recipient area does not lend itself to grafting by using the Dermatape splint, and suturing of the graft alone is indicated, the graft may be stripped from the Dermatape with its external surface entirely free of cement. The union of the green rubber and red skin cement is permanent.

10. At the time of the first dressing, usually five days, the external dressings are removed and the Elastikon retaining strips are carefully removed without

PLATE I



Photograph of Dermatape with descriptive instructions

disturbing the strips of Dermatape (Plate III). This is easily done with the aid of ether.

11. The strips of Dermatape are now removed in reverse order of their application as nearly as possible. In doing so care must be exercised in the process of lifting the edges that overlap the lesion. It will be found that those portions of the graft that overlap the edges are partially necrosed, and they tend to cling to the Dermatape rather than to the good skin. This portion is carefully peeled from the Dermatape to the beginning of the lesion. From this point the Dermatape readily separates from the graft. The overlapping edges necrose and amputate themselves in about two weeks.

12. Subsequent dressings are applied as required, usually a smooth, dry dressing to protect the graft and absorb drainage.

The introduction by Padgett of a rubber cement as an aid in the excision of split skin grafts is a milestone in the field of plastic surgery, in spite of the fact that some modifications of his original technique have been found desirable. The use of rubber cement, however, has created some problems especially in the removal of the graft from the drum and its subsequent management, and the modification suggested by Webster incorporating the use of pliofilm as a splint to the graft was a progressive thought toward overcoming them. Unfortunately the medium of pliofilm is not without some serious drawbacks, chiefly among these is the fact that the pliofilm is very thin and lacks sufficient body to prevent wrinkling, and that its application to the drum requires skillful assistance. In developing the Dermatape these points have been considered, and we present it with the following properties:

1. It can be applied with ease to the dermatome by one person.[3]
2. It is readily made a part of the excision mechanism without being cemented to the drum.
3. After excision it is removed with the graft as a unit and remains so during successive steps, the graft being held at its normal tension.
4. It has sufficient body to maintain its shape and resist the natural contractility of the graft.
5. It can be used with or without sutures, in strips or in postage stamp form.
6. The graft can be removed from the Dermatape, free of cement, for suturing if so desired.
7. Pattern grafting can be accomplished by outlining the pattern on the red rubber side.
8. Lends itself well for securing to recipient area by elastic adhesive tape.
9. Since the Dermatape is applied to the drum mechanically there is no time loss in excising successive drums.
10. Separates readily from the graft at first dressing.

CASE REPORTS

Case 5081. M. S., age 42 years, female (Plate II). Recurrent malignant melanoma of back. Lesion had been widely excised twice previously. Massive excision and grafting of

[3] A two and one-half inch and a four inch dermatome have been developed into which has been incorporated a mechanical device for securing and tightening the Dermatape.

PLATE II

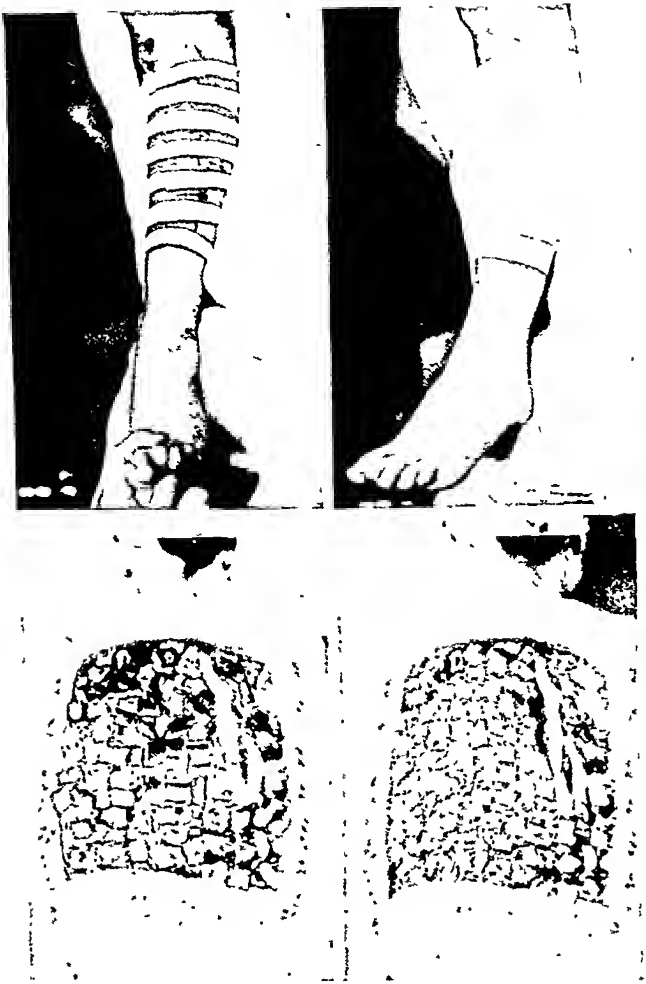


PLATE II (5081 and 7783)

Upper Left—Graft-bearing Dermatape strips secured to lesion by circumferential Elastikon bands.

Upper Right—Entire area covered with Elastikon.

Lower Left—Postage stamp application of Dermatape graft.

Lower Right—Immediately after removal of Dermatape.

PLATE III

PLATE III (Case 13901)

Upper Left—Ten year old traumatic ulcer showing cyanosis of surrounding tissue
Upper Right—Dermatape strips after removal of Elastikon bands with ether
Lower Left—Graft immediately after removal of Dermatape strips
Lower Right—Healed lesion twenty one days after grafting

denuded area with postage stamp Dermatape grafts. About twenty per cent of the grafts were lost due to faulty immobilization. Patient discharged from hospital in fifty-five days with lesion about ninety per cent healed.

Case 7783. N. H. age 18 years, female (Plate II). Malignant melona of left leg, about three by four inches. Had not been previously operated upon. Patient's maternal grandmother had died in middle age of malignant melanoma. Very wide excision of lesion and graft with Dermatape strips. Patient discharged from hospital fourteen days after grafting with wound ninety-five per cent healed.

Case 13901. H. G. age 22 years, male (Plate III). At age of twelve patient injured left foot, leg and knee in truck accident. Developed osteomyelitis of the tibia, which was operated upon twice. Residual wound was a large, burrowing ulcer of the leg surrounded by poorly nourished, cyanotic skin. Ulcer has been dressed twice daily with ointments for eight years.

At the first operation all fibrous tissue was removed from the edges and bed of the ulcer. Patient was kept in bed for three weeks with leg elevated and moist dressings changed twice weekly. During this time the bed developed a scanty growth of granulation tissue, fibrous in character. Ulcer was grafted using Dermatape strips, which were removed in five days. Patient discharged with wound entirely healed twenty-one days after grafting.

REFERENCES

(1) Davis, John Staige: Transplantation of skin. Surg., Gynec. & Obst., 44: 181-89, 1927.

(2) Padgett, Earl C.: Calibrated intermediate skin grafts. Surg., Gynec. & Obst., 69: 779-93, 1939

(3) Webster, Jerome P.: Film-cemented skin grafts. Surgical clinics of North America, 251: 280 (Apr.) 1944.

(4) Berkow, Samuel G.: Tape method of skin grafting. U. S. Naval Med. Bulletin, 45: 1, 1945.

(5) Hardy, S. Baron, and McNichol, J. Wallace: The use of small pieces of film-covered skin grafts. Surgical Clinics of North America, 281-292 (Apr.) 1944.

PERMANENT PIGMENT INJECTION OF CAPILLARY HEMANGIOMATA

JAMES BARRETT BROWN, Col., M. C.

St., Louis, Mo

BRADFORD CANNON, Lt. Col., M. C.

Boston, Mass

AND

ALLYN McDOWELL, 1st Lt., M. C.

St., Louis, Mo

Capillary hemangiomata—or port wine stains—present major problems to many patients with wide spread lesions on the face and exposed areas. Cosmetics, such as Covermark and Sheridan cream, offer a solution for many patients, especially women, and excellent results may be obtained in obliterating the unsightliness of these lesions, if the patients will develop a good technique of

Fig 1. Improvement in Appearance of Capillary Hemangioma of Lip from Permanent Pigment Injection

application, and of wearing the preparations. For those who are adjusted to cosmetic application and are satisfied, nothing further need be done about the unsightliness. Men, workers who perspire, those who have long hours of duty and those who just don't want to go the the trouble of using the cosmetics, still may need some type of relief.

The destructive methods of treatment, such as freezing with carbon dioxide snow, cauterization, electrodesiccation, sclerosing solutions, radiation therapy, and surgical excision and grafting, are not entirely satisfactory. Smoothness of the surface is apt to be interfered with—even with excision and grafting, and as

far as the degree of unsightliness is concerned, there may not be much improvement—but merely a change. This change may be acceptable to some patients. Radiation dermatitis may add to the difficulties.

Hance et. al. in 1944 and Byars in 1945 have called attention to permanent pigment injection for color matching of skin grafts and flaps and for other deformities about the face.

The patient illustrated here was injected by Eliscu at Valley Forge General Hospital, and has improvement that can be photographically recorded, as shown.

The white pigment used was tatto white and Chinese white. Bleeding, which is usually profuse from the multiple puncture holes in the skin, can be reduced by preliminary chilling of the surface with ice.

The multiple stab wounds of the tattooing needles possibly might produce thrombosis of the capillaries in the region, to account for some improvement. But it seems apparent that the pigment has relieved, to a worthwhile extent, the intensity of the red in the hemagiomas.

SUMMARY

Permanent pigment injection (tattooing) may prove of benefit in some patients with capillary hemangiomas, and is recorded here, after a few trials, to call attention to its possibilities.

BIBLIOGRAPHY

1. Hance, G., Brown, J. B, Byars, L. T., and McDowell, F.: Color matching of skin grafts and flaps with permanent pigment injection. Surg. Gynec. & Obst., 79: 624 (Dec.) 1944.
2. Byars, L. T.: Tattooing of free skin grafts and pedicle flaps. Ann. Surg., 121: 644 (May) 1945.

EXPERIMENTAL OBSERVATIONS ON THE GROWTH OF YOUNG HUMAN CARTILAGE GRAFTS

LYNDON A. PEER, M.D.

Newark, N. J.

Normal growth of all cartilage structures in the body during childhood takes place from the deep layer of connective-tissue cells of the perichondrium. These connective-tissue cells form a matrix substance about themselves, separate from the perichondrium, and become cartilage cells. Growth also occurs by division of cartilage cells, followed by the production of a matrix about each cell separating one from another. After adult life, cartilage ceases to grow, and there is considerable doubt concerning its powers of regeneration following injury; the cartilage wound usually being filled in by connective tissue associated with little if any new cartilage formation.

Adult autogenous cartilage grafts maintain their cartilaginous structure following transplantation but neither increase nor decrease in size, the growth property being absent. Dupertius, in 1941, demonstrated the actual growth of young auricular and costal cartilage grafts in rabbits. This indicated the possible importance of using autogenous grafts in the growing child. Following Dupertius' work with rabbit cartilage, I buried fifteen autogenous cartilage grafts—rib, septal and ear cartilage—without perichondrium in eight infants or small children. I removed the grafts at intervals from one year to two years and three months after transplantation. At the time of transplantation and at the time of removal all these grafts were measured in length and width, and in some cases, thickness.

A study of these measurements demonstrated that all of the thinner auricular and septal cartilage grafts increased somewhat in size. Two of the thicker rib cartilage grafts showed an appreciable increase but four rib grafts buried in the same individual showed no growth after two years and two months. This indicated an individual variation in the rate and amount of growth for some thick rib cartilage grafts which was not evident in the thinner septal and auricular cartilage grafts.

The average rate of increase in the thin grafts was about $\frac{2}{32}$ of an inch in length over a period of two years. In twelve years, this same growth rate would amount to $\frac{3}{4}$ of an inch. This is a sufficient increase to justify the use of autogenous cartilage grafts in children in order that growth of the transplanted cartilage keep pace with the general growth of the region grafted.

On section all of these cartilage grafts showed normal appearing cartilage cells and matrix with a complete absence of invasion or absorption. Both the elastic ear cartilages and the hyalin septal and rib cartilages retained their characteristic structures.

DISCUSSION

If growth takes place in a young cartilage graft, what is the mechanism of this growth?

Recalling the normal growth of untransplanted cartilage structures in young individuals, one concludes that there are two possibilities:

FIG. 1. A. Human adult autogenous septal cartilage graft buried without perchondrium for 5 years. Note absence of invasion and absorption. In a section of this graft in the fresh state the cells appeared as normal living cartilage cells. Twelve additional autogenous septal cartilage grafts buried for shorter periods also gave no evidence of invasion or absorption.

B. Human adult autogenous alar cartilage graft buried 4½ years. Note absence of invasion and absorption. In fresh sections of this graft the cells appeared as living cartilage cells. Seven additional autogenous alar cartilage grafts also gave no evidence of invasion or absorption.

C. Human autogenous elastic ear cartilage graft buried 4 years. When a section was made of this graft in the fresh state the cells appeared as living cartilage cells. Twelve additional ear cartilage grafts buried for shorter periods also showed no evidence of invasion or absorption.

D. Human autogenous rib cartilage graft buried without periochondrium for 14 years. Note absence of invasion and absorption. In fresh sections of this graft the cells appeared as normal living cartilage cells. Fourteen additional autogenous rib cartilage grafts also showed no evidence of invasion or absorption.

(1) Increase in size of a graft may be due to division of cartilage cells with the elaboration of a matrix substance about each cell, thus increasing both the bulk

of the graft and the number of cellular components. *This can occur only if the cells in the transplanted cartilage survive as living cartilage cells.*

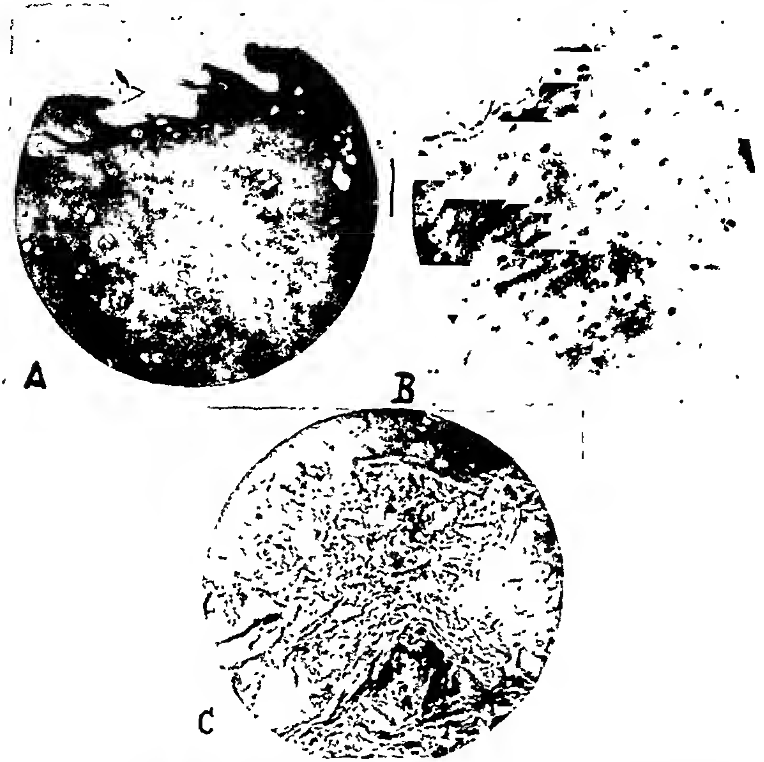


FIG 2. A. Human autogenous rib cartilage graft buried without perichondrium by Dr. John Staige Davis to repair a saddle depression in the nose. The draft became distorted. I removed about one-third of the transplanted cartilage 20 years after it hsd been inserted in the nose by Dr Davis Serial sections were made from the portion of the graft removed at operation, all of which showed complete absence of invasion and absorption. In studies made of this graft in the fresh state the cells appeared as living cartilage cells

B. Human autogenous rib cartilage graft buried by Dr. George Dorrance to support a saddle nose. The graft became distorted, and was removed 25 years later by Dr. Warren Davis, who immediately sent me the specimen immersed in normal saline solution. After making sections of the fresh cartilage I found that the cells appeared as normal cartilage cells, which took the supravital stains as living cells. Fixed and stained serial sections showed complete absence of invasion and absoprtion This human autogenous cartilage graft buried 25 years represents the oldest of its kind to be examined microscopically thus far reported in the literature

C. Human preserved cadaveric rib cartilage graft buried for 18 months. Note the absence of cell structure and the invasion of the cartilage by connective tissue. This preserved cadaveric cartilage graft is in the process of absorption.

(2) Increase in size of a graft could arise from activity of connective-tissue cells surrounding the grafts, by the elaboration of a matrix substance about each cell and the incorporation of this matrix substance in the graft structure. This also would increase both the bulk of the graft and the number of cellular components.

I do not know which of these factors is responsible for the apparent growth of young human cartilage grafts.

The fact that the cells in any human autogenous cartilage graft (young or adult) survive successful transplantation as living cells may be demonstrated

TABLE 1

*The amount of growth occurring in various cartilage grafts**

AGE OF CHILD	TYPE OF CARTILAGE GRAFT	MEASUREMENT WHEN TRANSPLANTED†	TIME BURIED	MEASUREMENT AFTER REMOVAL	INCREASE SIZE
yr		*in*	*yr*	*in*	*in*
7	Septal, without perichon	L $\frac{8}{32}$ W $\frac{5}{32}$	$1\frac{6}{12}$	L $\frac{10}{32}$ W $\frac{6}{32}$	L $\frac{2}{32}$ W $\frac{1}{32}$
4	Costal, with perichon on one side	L $1\frac{9}{32}$ W $\frac{10}{32}$ T $\frac{6}{32}$	1	L $1\frac{13}{32}$ W $\frac{11}{32}$ T $\frac{7}{32}$	L $\frac{4}{32}$ W $\frac{1}{32}$ T $\frac{1}{32}$
2	Costal, with perichon on one side	L $1\frac{10}{32}$ W $\frac{10}{32}$ T $\frac{6}{32}$	$1\frac{3}{12}$	L $1\frac{13}{32}$ W $\frac{12}{32}$ T $\frac{6}{32}$	L $\frac{3}{32}$ W $\frac{2}{32}$ T none
$1\frac{10}{12}$	Auricular, without perichon	L $\frac{15}{32}$ W $\frac{5}{32}$	1	L $\frac{17}{32}$ W $\frac{6}{32}$	L $\frac{2}{32}$ W $\frac{1}{32}$
$2\frac{1}{12}$	2 auricular, without perichon same patient	L $\frac{14}{32}$ W $\frac{4}{32}$	2	L $\frac{16}{32}$ W $\frac{5}{32}$	L $\frac{2}{32}$ W $\frac{1}{32}$
$1\frac{11}{12}$	Auricular, without perichon	L $\frac{15}{32}$ W $\frac{5}{32}$	2 [illegible]	L $\frac{18}{32}$ W $\frac{7}{32}$	L $\frac{3}{32}$ W $\frac{2}{32}$
$2\frac{3}{12}$	2 costal, with perichon	L $1\frac{8}{32}$ W $\frac{8}{32}$ T $\frac{6}{32}$	$2\frac{2}{12}$	L $1\frac{8}{32}$ W $\frac{8}{32}$ T $\frac{6}{32}$	none
$2\frac{3}{12}$	2 costal, without perichon	L $\frac{10}{32}$	$2\frac{2}{12}$	L $\frac{10}{32}$	none
$\frac{6}{12}$	Auricular, without perichon	L $\frac{12}{32}$ W $\frac{7}{32}$	$2\frac{1}{12}$	L $\frac{14}{32}$ W $\frac{8}{32}$	L $\frac{2}{32}$ W $\frac{1}{32}$

* A preliminary summary of this work was reported in Archives of Otolaryngology, 42: 384 (Nov–Dec) 1945.

† L = length, W = width, T = thickness

in the following way:[1] Immerse the fresh cartilage graft in melted paraffin which is about to solidify. When solidification occurs, place the paraffin block contain-

[1]This method was used for an adult autogenous rib cartilage graft buried without perichondrium to support a saddle nose and removed 20 years later, for an adult autogenous septal cartilage graft buried without perichondrium for 5 years, for an adult elastic ear cartilage graft buried without perichondrium for 4 years, and for an adult alar cartilage graft buried 4½ years. In all of these instances the cartilage cells appeared viable. Studies of the young cartilage grafts showing growth revealed that these cartilage cells also were viable.

ing the fresh cartilage graft in a microtome and make sections, which are caught in a solution of normal saline to prevent drying and death of the cartilage cells. The sections are then placed on a slide, covered with a few drops of normal saline, and examined under low and high power magnification.

The fresh cartilage cells will be seen clearly in their normal state, completely filling the lacunae, with reticular cytoplasm and large well-demarcated nuclei. *Obviously these are living cartilage cells.* As the saline solution evaporates, the cartilage cells will be seen to retract from the walls of the lacunae and lose all form of normal cell structure, thus resembling the cells in preserved cadaver cartilage grafts or in autogenous cartilage grafts in which improper technic has been used in fixation.

One may also apply supravital dyes to the fresh section of a cartilage graft and note that only the cytoplasm of the cells takes the dye, thus demonstrating that the cartilage cells are viable. As the saline solution evaporates, the nuclei of the cartilage cells begin to take the dye, which indicates death of the cell due to desiccation.

Examination of the young human autogenous cartilage grafts in the fresh state by this method demonstrated that the cartilage cells in all of these grafts had survived transplantation as living cartilage cells with theoretical growth possibilities.

Since there was no evidence of invasion in any of these grafts from the surrounding host tissue, one must conclude that the cells in the cartilage grafts were either the original cells present at the time of transplantation or the descendants of these original cells.

CONCLUSION

1. Experimental evidence is presented indicating that young human autogenous cartilage grafts tend to increase in size following transplantation.

2. A method for the microscopic examination of fresh cartilage grafts is described. When young autogenous cartilage grafts were examined by this method, the cells in the grafts appeared as living cartilage cells with theoretical growth possibilities.

3. *All forms of autogenous cartilage,* whether young or adult, survive successful transplantation as living cartilage which is not subject to invasion or absorption.

4. Older statements in the literature that ear cartilage and septal cartilage are absorbed following transplantation have no basis in fact.

TRAINING IN PLASTIC SURGERY—VISUAL AIDS

ARTHUR PALMER, M.D.

Among the various surgical specialties plastic and reconstructive surgery has advanced most rapidly in the last three decades. This specialty is by no means new. Historically it seems likely that plastic surgery was practiced soon after ophthalmic surgery, the first type of surgery recorded. About two thousand years ago King Glorka demanded as retribution from the inhabitants of a conquered city, that their noses be amputated, and thus the demand for plastic surgery among the Hindus arose. No one cared to go about without a nose if it could be restored. Some of the methods of restoration used today are modifications of old Hindu and Italian techniques. Since those ancient times every conflict of man has resulted in traumatic deformities requiring repair. During World War II many severely wounded soldiers and civilians, spared by prompt medical care with the use of blood plasma and chemo-therapy, were admitted to plastic surgery miltiary centers. A high percentage of such cases failed to survive their injuries in previous wars. At the present time there are seven Army Hospitals in the United States established especially for the care of patients requiring plastic and reconstructive operations. It is agreed by all that, "The casualty from the field of battle has a right to expect and demand the optimal result which can accrue from a highly cooperative professional service and a skill which results from the utilization of all that is best in the general and special experience related to his particular problem." (Smith (1)) The wounded soldier's mental comfort and success in the competition of living is often dependent upon the successful completion of plastic surgery. The same principles apply to civilians who need help in the correction of deformities which may cause profound mental as well as physical handicaps.

Plastic surgery is a branch of general surgery which deals with the correction of congenital and acquired defects in any part of the body. In skilled hands it serves to restore function, to improve appearance and to relieve mental distress. Prejudice and misconception as to the aims of plastic surgery has been firmly fixed in the minds of many misinformed individuals. This is largely due to the fact that many persons in need of expert surgical help have been exploited and victimized by the unscrupulous quack or charlatan, particularly in that branch of plastic surgery commonly known as cosmetic surgery. Davis (2) states that "Professionally plastic surgery demands the same familiarity with the fundamental sciences and the same application of surgical principles which are essential in any type of surgery and in addition a refinement of technique and a sense of geometric grouping and artistry not commonly called for in the execution of most surgical procedures."

In order to assist the laity, as well as the medical profession, in differentiating to some degree between the competent and the incompetent among those physicians practicing specialties, the American Board of Ophthalmology was incorporated in May 1917. Many other specialty boards have since been estab-

lished. The American Board of Plastic Surgery was tentatively organized in June 1937 by representatives of widely distributed groups interested in this specialty, and was recognized as a subsidiary of the American Board of Surgery in May 1938. In May 1941 this Board was given the status of a major board by the Advisory Board of Medical Specialties. The organization of these specialty boards has done much to instill confidence in the ability of the specialist who is a diplomat to excel in his special field. Not all qualified specialists are certified by these specialty boards but the great majority are, and certainly such a certification is greatly to their advantage.

Since it is apparent that the position of plastic surgery is rapidly advancing, and we may well assume that shortly it will rank with other well established surgical specialties in all respects excepting in volume of work, it seems appropriate to make an examination of the present status of the teaching of this specialty, with particular emphasis upon certain modern methods and materials available.

At the present time there are nine residencies in plastic surgery approved by the committee on hospital standardization in five different hospitals in the United States. This compares with fourteen hundred and fifty-two residencies in general surgery in three hundred and thirty hospitals, and five hundred and eighty-two residencies in eye, ear, nose and throat in one hundred and twenty-five hospitals. Only in traumatic surgery are there fewer residencies available, four in three hospitals. There are seven Army Hospitals with Plastic Surgery Centers but only the United States Veterans Hospital in New York City has a training center with a resident staff, offering two or three year training courses. Certain short courses without residencies are offered well qualified graduates and serve a useful purpose. It is evident however that opportunities for graduate training in plastic surgery in this country are limited.

While we cannot hope to standardize the personal qualifications of a teacher of medicine, and there will always be a certain few natural born great teachers, and many whose abilities are average, all may take advantage of certain valuable aids in teaching and thus increase their usefulness. Training in pedagogy is rare for the teacher in medicine. Life is short and medical education long and very few members of medical faculties have had the time or means to pursue the study of pedagogy over any appreciable length of time. Consequently the person entrusted with the training of both graduate and under-graduate students should avail himself of every possible aid in presenting his topic. His armanentarium should be complete.

It is essential that the student of plastic surgery have thorough training in the basic subjects such as anatomy, physiology, pathology and physical chemistry, at the start. In time his most valuable experience will be gained in the operating room where he will assist at and perform the various types of plastic operations himself.

Meantime during the course of instruction certain visual aids may be employed to advantage by the instructor. These additional aids fall largely into the classification of such visual aids as the motion picture, photographs, lantern slides and models illustrating operative procedures. The usefulness of visual

aids in medical education has been emphasized by Smiley (3) "During World War II the Navy alone trained more than one hundred thousand men and women who had had little or no medical preparation in the essentials in the care of sick and wounded as hospital corpsmen, and ten thousand physicians were prepared to meet new responsibilities as Naval Medical Officers in all parts of the world." About one hundred and fifty training motion picture films were used in this program. Such films must be accurately prepared and are best used as accessories to the introductory lecture. Sound pictures, of course, offer certain advantages over the silent film. Repeated use of the same film affords the student opportunity to absorb the content thoroughly. Colored photography is often a decided advantage in the field of plastic surgery. Many films have been made on a variety of topics. To my knowledge motion pictures illustrating the treatment of burns, maxillary fractures, skin transplants and skin grafting, the use of tubed pedicle flaps, repairs of cleft palates and hare lips, cartilage grafts, repair of tendons, eye, ear and nose plastics, mammaplasties and plastics on the genital organs have been made. It would be an advantage to have all such films listed by a central bureau and made available to qualified teachers. The American College of Surgeons is making good progress in this direction. Films reviewed and approved by their committee on motion pictures are certain to be of real educational value. To provide wider distribution copies of these films may be made which are quite satisfactory.

Properly prepared and edited the sound motion picture is one of the best means of imparting information to the student. Functional results are best illustrated by motion and the student is trained by the coordination of sight and sound.

Lantern slides and photographs: The teaching value of lantern slides and photographs deserves emphasis. The student's interest is held more closely by a well illustrated talk than by a didactic lecture when often sooner or later attention suffers from an irresistible state of drowsiness. One of my former professors after thirty minutes of the presentation of dry facts was in the habit of saying, "For the benefit of those who are still awake we shall proceed to the next topic." His words were quite appropriate to the occasion. The lantern slide offers a means of giving a clear outline of the lecture. It will illustrate the historical background of the topic both in respect to the individual and the method. In addition it will represent fairly accurately defects to be corrected and the results of surgical procedures. We should emphasize again the importance of having the lantern slide accurate and properly titled. Photographs are particularly useful in sectional teaching and exhibits.

Models: Wax and plastic models representing various states of operative procedure are particularly useful for study by small groups of students. These models may be made with transparent materials representing skin and one views the various steps in the operation on the bony and soft tissue underneath, as through a window. Some such models are shown in figures 1 and 2.

Waters (4) speaking of visual education in the medical schools, states, "All methods of visual-audio acquisition of knowledge should be made available to

medical students and teachers and post graduate seekers of information.... The availability is the prime necessity .... It would be advantageous for all schools to maintain and support a department given over to the production of all types of teaching material, and to incorporate a film library."

FIG. 1. MODELS SHOWING THE TECHNIQUE OF RIB CARTILAGE TRANSPLANT FOR SADDLE BACK NOSE BY INSERTION OF THE CARTILAGE THROUGH THE COLUMELLA

FIG. 2. MODELS ILLUSTRATING THE VARIOUS STEPS OF THE JOSEPH OPERATION FOR DORSAL HUMP, LATERAL DISPLACEMENT AND LOW NASAL TIP

Recent inventions and scientific developments may well influence the position of visual education to a profound degree. The practical adaption of television, radar, and electronics may revolutionize some of our present methods of instruction. Medical educators should be alert to their possibilities.

Whatever may take place in this direction, it is certain that there will never be a substitute for a friendly, sympathetic and stimulating interest on the part

of the teacher in his pupil, nor for an energetic devotion to his task on the part of the student.

SUMMARY

1. Plastic Surgery one of the oldest surgical specialties has advanced rapidly in the past three decades following the world wars.

2. Organization of the American Board of Plastic Surgery (1937–1941) has improved the status of this specialty.

3. Opportunities for training in this field of surgery are still limited. In the United States nine residencies are available in five medical centers.

4. Training in Plastic Surgery is discussed with emphasis on the use of certain aids such as the motion picture, photographs, lantern slides and models.

5. Educators should be alert to the possible practical application of television, radar and electronics to teaching in the future.

REFERENCES

1. Smith: Manual of Plastic Surgery, p. 3.
2. Davis: Annals of Surgery, pp. 641-653 (May) 1941.
3. Smiley: Journel of Association of American Medical Colleges, 21: (no. 2) 91-95 (March) 1946.
4. Waters: Journel of Association of American Medical Colleges, 21: (no. 2) pp. 85-90 (March) 1946.

REPAIR OF FACIAL DEFECTS BY LOW-NECK PEDICLE FLAPS[1]

ROBERT H. IVY, M.D.

From the Plastic Surgery Service, Presbyterian Hospital, Philadelphia

A fundamental principle in the restoration of facial defects is the avoidance, if possible, of additional visible scars. A second is, where possible, the replacement of lost surface tissues with skin of similar color and texture. The first principle is generally violated by the use of a flap from the forehead in rhinoplasty or meloplasty, although this conforms well to the second principle. The second principle is violated by the use of flaps from the arm, chest abdomen or back, which seldom match the skin of the face in color or texture.

I wish to report experience with the use of tube pedicle flaps from across the lower part of the neck for repair of defects of various parts of the face. I am aware that this source of tissue has been used by many others, for example J. P. Webster and T. G. Blocker, but in my opinion it has not been stressed as often as its merit deserves. This skin and subcutaneous tissue is devoid of hair, and in texture and color is very similar to that of the face. The scar resulting from its removal from the neck is usually inconspicuous and can be readily concealed in most cases. To obtain sufficient length to the pedicle to reach the part to be repaired, the horizontal incisions may safely cross the midline, so that one attachment of the pedicle is on the right and the other on the left. That this can be successfully done refutes the popular dictum that a pedicle should never cross the median line of the body. We have even made a tube pedicle from a strip of skin and subcutaneous tissue, two inches wide, from one side of the neck to the other, without a temporary intervening bridge at the median line. However, to avoid the danger of thrombosis and necrosis at the middle of the tube, it is best in most cases to leave a median bridge for ten days to two weeks, before completion of the tube. The defect in the neck can be readily closed with little tension by undercutting its edges. The tube should be composed of skin and subcutaneous tissue down to the superficial fascia, but not include the platysma or other muscle.

The following cases illustrate the use of this method of repair.

Case 1. A young married woman received injuries in an automobile crash while riding on the front seat. Broken windshield glass sliced off part of the nose, including some of the right ala and tip and other tissues up to the lower border of the nasal bone, and also produced a severe and deep laceration of the right cheek.

After healing, there remained a broad, deep, irregular scar in the right cheek. The principal deformity, however, was a large defect in the right side of the tip, anterior part of the ala and dorsum of the nose in the lateral cartilage region. The remaining distal portion of the ala was drawn up by scar tissue so that its lower border was in a vertical position (fig. 1). The size of the defect and the amount of surrounding scar precluded satisfactory repair by use of local tissues. A 1½ inch wide strip of skin and subcutaneous tissue was raised across the lower part of the neck, just above the clavicles, an unsevered bridge ¾ inch long being

[1] Presented at the Meeting of the American Association of Plastic Surgeons, Toronto, June 3, 1946.





FIG 1. (UPPER LEFT) CASE 1. SHOWING DEFECT OF RIGHT SIDE OF NOSE AND SCAR OF RIGHT CHEEK

FIG. 2. (UPPER RIGHT) CASE 1 TUBED LOW-NECK FLAP TO BE USED LATER FOR REPAIR OF NOSE AND CHEEK

FIG. 3. (CENTER LEFT) CASE 1. ONE END OF FLAP FROM NECK HAS BEEN TRANSFERRED TO NOSE, THEN THE OTHER TO CHEEK

FIG 4 (CENTER RIGHT) CASE 1 PROFILE VIEW OF REPAIRED SIDE OF NOSE

FIG. 5. (BOTTOM) CASE 1. FRONT VIEW, SHOWING RESTORATION OF RIGHT ALA OF NOSE

Fig 6 (Upper left) Case 2 Healed Defect of Tip and Alae of Nose Front View
Fig 7 (Upper right) Case 2 Healed Defects of Tip of Nose and Right External Ear
Fig 8 (Center left) Case 2 End of Tubed Neck Flap Transferred to Tip of Nose
Fig 9 (Center right) Case 2 End of Remainder of Tubed Neck Flap Transferred to Region of Right Ear
Fig 10 (Bottom) Case 2 Result of Repair of Tip of Nose and External Ear by Same Tubed Neck Flap

Fig 11

Fig 12

Fig 13

Fig 11 Case 3 Depressed Post-Radiation Scar of Left Cheek Tubed Flap Across Lower Neck with Temporary Bridge at Midline
Fig 12 Case 3 Same as Fig 11 Median Line Bridge Severed and Tube Completed Across Neck
Fig 13 Case 3 Right End of Tubed Neck Flap Severed, Opened Out and Sutured into Defect Left by Partial Excision of Scar of Left Cheek

left at the midline. On each side of this bridge the flaps were tubed and the resulting defects closed in the usual manner. Two weeks later the bridge was severed and the tube completed to give a pedicle extending from beneath the mastoid region of one side to that of the other (fig. 2). After a three-week interval, a lining for the nostril was made by turning over a flap of skin covering the displaced right ala and suturing its edge to the freshened skin edge on the septal side of the defect. The left end of the cervical tube was then severed, thinned out and sutured over the lining flap to the freshened edges of the defect. Three weeks later the right end of the tube was severed from the neck and after some of it was discarded, the remaining end was implanted in the cheek after excision of part of the scar there (fig. 3). Subsequently, the excess of tissue from the tube was excised, the remainder being thinned out and sutured to complete the shaping of the nose repair and improve the scarred area on the cheek. The final result is shown in figures 4 and 5.

Case 2. A man 38 years of age was injured in a chemical explosion, the tip and part of the right ala of the nose, and the upper part of the pinna and the lobe of the right ear being carried away. The healed defects are shown in figures 6 and 7. For reconstruction of the missing part of the external ear, the post-auricular skin was not available, as the hairy scalp extended very close to the attachment of the ear. It was decided to use a tubed pedicle flap from the lower cervical region for repair of both ear and nose defects. A tubed pedicle was prepared horizontally across the neck in one stage, without any intervening bridge at the median line. Three weeks later the left end was severed, and sutured to the freshened edges of the defect in the tip and right ala of the nose, after a lining for the nostril had been furnished by inverting surrounding skin (fig. 8). After another three weeks' interval the pedicle was cut and the free end of the edge used to repair the nose was trimmed and sutured to the surrounding skin. The remaining pedicle was found to be long enough to reach the anterior end of the ear defect, where it was sutured into a freshened area at this point (fig. 9).

After several operations to bring the pedicle to proper position, size and shape to replace the missing part of the ear, a thin sickle-shaped piece of preserved costal cartilage was inserted to stiffen the new ear margin. The missing lobe was reconstructed by means of small local flaps. Figure 10 shows the end result of the nose and ear repair.

Case 3 was a young woman with a square, depressed scar on the left cheek, about $1\frac{1}{2}$ by 1 inch in area, resulting from irradiation treatment of a pigmented nevus in childhood. The scar was white in color for the most part, and there was some retraction of the lower eyelid (fig. 11). The lack of contour precluded the use of a free skin graft, and repair by multiple excision and gradual advancement of local tissues did not seem feasible. A transverse, low cervical tubed pedicle was prepared, completion of the tube being preceded by a median bridge of skin (figs. 11 and 12). Five weeks after the first operation the right end of the cervical tube was severed, and circulation from the left end found to be satisfactory. The upper portion of the scar on the left side of the cheek was excised, the free end of the cervical tube opened, flattened out and thinned, and sutured to cover the raw area left by excision of the cheek scar (fig. 13). Three weeks later, the remainder of the cheek scar was excised, the tube from the neck divided, and the end attached to the cheek opened, thinned and spread out, then sutured in place to cover the raw area. Some later correction of margins will be required, and final result is therefore not shown.

RECONSTRUCTION FOR PARTIAL LOSS OF EAR

Case Reports[1].

JACQUES W. MALINIAC, M.D.

It is generally admitted that it is difficult to attain perfection in plastic repair of total or partial loss of ear. The main reasons for this are the intricate form of the auricle and the thinness of the skin and cartilaginous frame. Another problem is to set the reconstructed auricle at a proper distance from the head. Moreover, an apparently suitable cartilaginous graft and skin covering made available at the time of surgery may subsequently undergo changes due to scar formation and partial absorption of the graft; this eventually compromises the contour and position of the reconstructed ear.

The cases presented here are shown not for the purpose of demonstrating any particular procedure, but rather to bring out the difficulties encountered and the necessity for improvising individualized methods of repair. In both instances, the retroauricular skin directly adjacent to the defects and usually utilized in the repair was not available because of scarring. The location of the loss in the upper part of the auricle (case 1) rendered adequate skin grafting of the retroauricular area inadvisable for fear of producing a secondary deformity by replacing hair-bearing skin with a skin graft.

In one of the cases (case 2) a fine retroauricular tube was used instead of the supraclavicular tube-flap long considered a good reproduction of the helix. This narrow tube could have been considered risky in a small child. However, when properly delayed with an intermediary bridge to assure adequate blood supply, it serves well and results in a finer skin with a less conspicuous scar. The supraclavicular skin tube should include a limited amount of subcutaneous fat in order to simulate the finely shaped helix.

Case 1. Adult male, showing loss of upper auricle following road injury, during which he also sustained deep lacerations of the cheek with loss of full thickness skin in the temporal and supra-auricular area (fig. 1). The patient was first seen by me in 1941, nine years following injury. An attempt had been made elsewhere to repair the loss by means of a flap from the back of the neck (fig. 8) but had proved unsuccessful, and the balance of the flap had been returned to the donor site leaving additional scarring.

The necessity for a normal foundation for repair of the loss required shifting of the skin of the cheek over the excised scar area. This in turn brought the hair-bearing surface of the temple nearer the auricle. In view of the scarring on the head above the defect, it might have been acceptable to replace the scarred area with a free skin graft. But this would have required the sacrifice of the hair-bearing surfaces on the temple and thus have added to the deformity. To avoid this, a procedure was followed in which the reduced amount of available skin and an additional secondary skin graft in the same location were used to replace the skin loss on the auricle. A supraclavicular tubed flap was used to reconstruct the helix (fig. 10).

---

[1] Presented at the Annual Meeting of the American Society of Plastic and Reconstructive Surgery, New York City. October 13, 1945.

FIG 1

FIG 2

FIG 1 CASE 1 LOSS OF UPPER HALF OF AURICLE WITH SCARRING OF CHEEK AND TEMPORAL AREA

The scarring precludes the use of sufficient retroauricular skin for the repair A larger skin graft above the defect would entail secondary deformity from the sacrifice of hair-bearing surface

FIG 2 CASE 1 ELIMINATION OF PERIAURICULAR SCARRING

Note the limited area of available non hair bearing skin above the defect

FIG 3

FIG 4

FIG 3 CASE 1 LOBULATED AREA OF SKIN (1) WITH A LAYER OF FRAGMENTED CARTILAGINOUS GRAFT

FIG 4 CASE 1 LOWER CARTILAGINOUS PEDICLE INCORPORATED IN EAR, LINING UNDER THE GRAFT (X) INSERTED TO PROVIDE UPPER HALF OF ANTHELIX SUPRACLAVICULAR TUBE IN PROCESS OF MIGRATION

Figure 2 shows the elimination of the scarred area around the defect Note the partly scarred skin available above the auricle A thin layer of fragmented cartilage was inserted beneath this and detached from the skull following skin grafting (fig 3) An additional

area of auricular surface was provided by inserting a thin layer of cartilage under the skin graft x (fig. 4). Prior to its transfer to the auricle this part consisted of two layers of

FIG. 5 FIG. 6

FIG. 5. CASE 1. TUBED PEDICLE ATTACHED ABOVE TRAGUS (1). UPPER PART OF CONCHA (2) FORMED BY TWO LAYERS OF SPLIT GRAFT CONTAINING FRAGMENTED CARTILAGE

This was subsequently raised on a narrow pedicle and attached to the upper border of the defect. The narrow pedicle was sufficient to provide adequate blood supply.

FIG. 6. CASE 1. SUPRACLAVICULAR TUBE ATTACHED AT BOTH ENDS TO RECONSTRUCTED ANTHELIX

FIG. 7 FIG. 8

FIG. 7. CASE 1. LATERAL VIEW—POSTOPERATIVE
FIG. 8. CASE 1. POSTERIOR VIEW—PREOPERATIVE

split skin with a layer of fragmented cartilage between them attached to the head on a narrow pedicle.

A supraclavicular tubed flap was prepared and transferred in stages for attachment to

Fig. 9

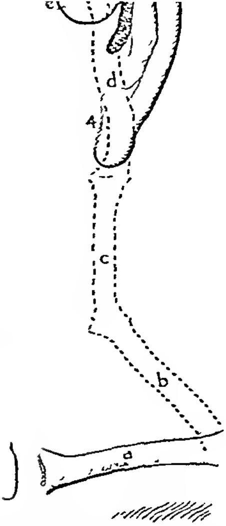


Fig. 10

Fig. 9. Case 1. Posterior View. Postoperative Photograph. Protruding Normal Ear Corrected in Usual Manner to Procure Symmetry
Fig. 10. Case 1. Diagram of Reconstruction. Shows Migration of a Supraclavicular Tubed Flap to Form Helix (a—2)

(1) and (2) show lower and upper parts of defect reconstructed by retroauricular skin and repeated split grafts with layers of fragmented cartilage. (3) Line of attachment of helix. (4) Attachment of lobule.

Fig. 11

Fig. 12

Fig. 11. Case 2. Loss of Helix at Upper Anterior Angle with Scar Contracture in Anthelix and Scarring of Temple (Shown by Dotted Line) Following Dog Bite
Fig. 12. Case 2. Retroauricular Tubed Flap Transferred in Lower Two-Thirds

Fig. 13

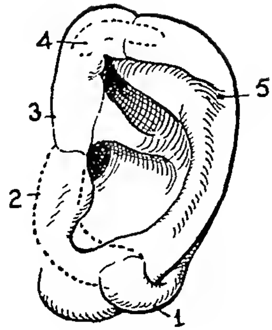


Fig. 14

Fig. 13. Case 2. Flap (A) in Place Prior to Junction with Helix (H). Temple Skin Advanced Following Excision of Scarred Area

Fig. 14. Case 2 Diagram (1), (2), and (3) Migration of Retroauricular tubed Flap; (4) Cartilaginous Graft to Helix; (5) Scar Contracture

Fig. 15. Case 2. Reconstructed Part of Helix (Raised by Hook) Became Depressed Due to Partial Resorption of Cartilage Graft

the cartilaginous part. *Note that the end of the tubed pedicle is attached deep in the concha above the tragus to reproduce the missing crus of the helix* figs 5, 6).

The interesting points in the reconstruction of this loss are the limited amount of available retroauricular skin and the attempt, because of this, to reproduce the concha and anthelix in two stages. Also of interest is the safe transfer from the mastoid region to the remnant of the auricle of a pedicle consisting of two split grafts with a cartilaginous layer between them. For the purpose of symmetry the normal protruding ear was corrected in the usual manner by shaping of anthelix and retroauricular skin excision (fig. 9). The shape of the reconstructed part has been preserved for the last three years without any change (figs 7, 9).

Case 2. Boy, age 4, with loss of part of helix at the upper anterior angle above tragus, scarring and contracture along curl of remaining helix from dog bite. There was also full thickness loss of skin on temple in area adjacent to defect (fig. 11).

Prior to repair of the loss, the scarred area on the temple was excised and normal skin advanced to the auricle. A narrow retroauricular tubed flap was transferred to the defect in stages (figs. 11, 12, 13). Because of the narrowness of the tube, the upper third was kept attached to the ear during the transfer of the distal end. The scarred area under the contracted remaining helix was excised and the surface skin-grafted. A curved preserved cartilaginous graft was inserted in the upper part of the reconstructed helix to provide support (fig. 14). However, in the course of a year this transplant weakened and autogenous cartilage will have to be inserted to provide more adequate curvature for the reconstructed part (fig. 15). Slight contracture of the skin graft is responsible for the existing bend of the helix. Release of the bend of the helix and insertion of an autogenous graft for support must await further growth of the ear. It is to be noted that the repair in this case was started at the age of five and that all stages except the first were done under local anesthetic.

FURTHER REPORTS ON THE USE OF COMPOSITE FREE GRAFTS OF SKIN AND CARTILAGE FROM THE EAR[1, 2]

COLONEL JAMES BARRETT BROWN
St. Louis, Mo.
LT. COLONEL BRADFORD CANNON
Boston, Mass.
MAJOR CARL E. LISCHER
St. Louis, Mo.
MAJOR W. BOWDOIN DAVIS
Baltimore, Md.
CAPTAIN ANDREW MOORE
St. Louis, Mo.
CAPTAIN JOSEPH MURRAY
Boston, Mass.

Losses of the ala, columella or tip due to trauma, burns, wounds, or operative causes, have always presented a problem in repair. Correction has usually necessitated the utilization of local flaps which may alter a normal feature, on or adjacent to the nose, or it may be necessary to transfer a remote flap which requires multiple procedures. The use of a free transplant from the ear comprising two surfaces of skin with cartilage between, has made possible these corrections in a single procedure. There is minimal deformity of the ear which is repaired either by closure of the defect, grafting of the raw surface, or the use of a scalp flap.

In the selection of suitable cases, it has been observed that grafts over 1 cm. in width are on the border-line of possible success. The length of the graft is apparently immaterial. The following variations in the method suggested in the original communication have been investigated further and can now be reported. For restoration of the normal curve at the junction of the ala and the columella, this graft is particularly suitable. It is also useful in marginal losses of the ala or, if there is alar shortening, it can be used as a wedge to elongate the ala. For flat restoration of the tip, a plaque of cartilage and skin can be used.

The removal of all marginal scar is essential to insure an adequate minute blood supply with as much vascular surface as possible for contact with the open surface of the transplant. This will enlarge the defect, but is necessary in preparation of the area for the graft. An accurate pattern of the resulting defect will aid in the selection of the most suitable donor area on the ear and will avoid deficient or excessive removal of normal ear tissue. Several parts of the ear have been utilized for donor sites, depending on the size and shape of the defect. The skin over the cartilage should be thin and care must be taken not to separate the skin and the cartilage. The most commonly used source is the outer margin of the helix which is usually repaired with a scalp flap in which the ear is buried. The flap is detached 2–3 weeks later and the open surface behind the ear grafted. The crus of the helix is used for smaller repairs, and can be repaired by direct

[1] Presented at the American Association of Plastic Surgeons, Toronto, June 3–4, 1946.
[2] This work has been done at Valley Forge General Hospital in association with Major Parke Scarborough, Major Edwin Shearburn, Major Byron West, Lt. Allyn McDowell, Lt. Milton Edgerton and Lt. James Jenson.

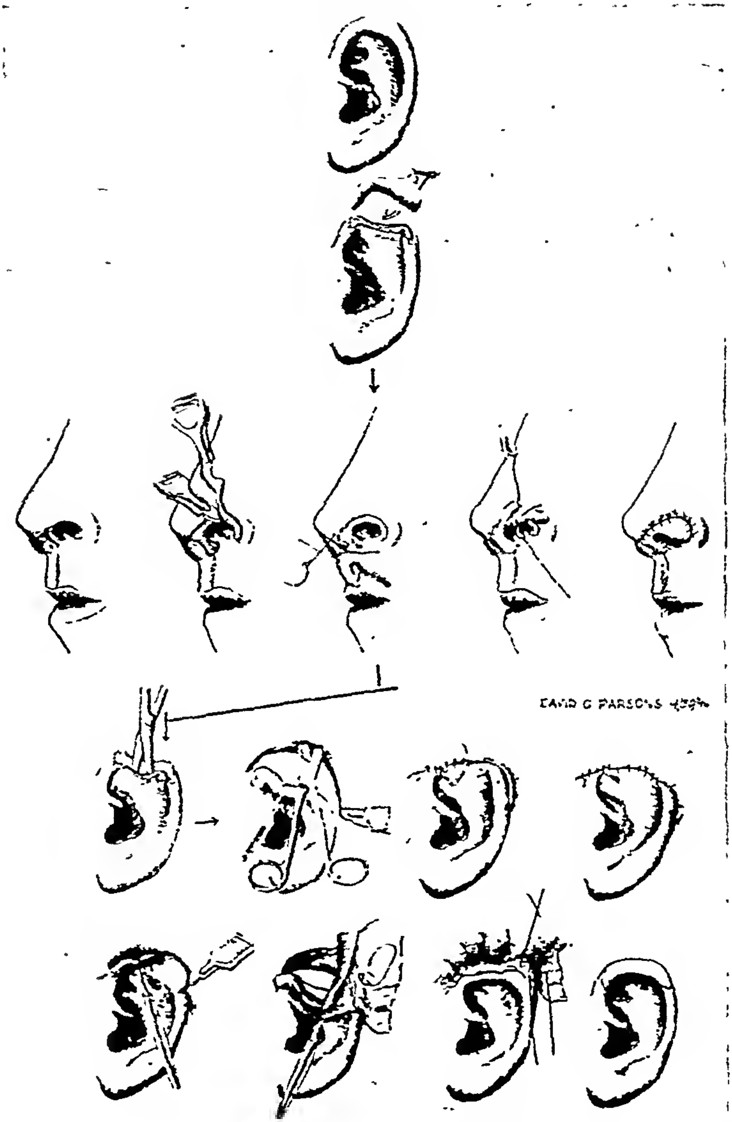


FIG. 1. ILLUSTRATING THE STEPS IN REPAIR OF NOSTRIL BORDER, TIP, AND COLUMELLA WITH COMPOSITE FREE GRAFT

closure. If the anti-helix or rim of the concha are used for a flat graft, they can be repaired either by closure or grafting. Occasionally, in losses of the ala due

to burns, the rim of the ear may also be damaged and no additional procedures will be necessary in correcting both deformities.

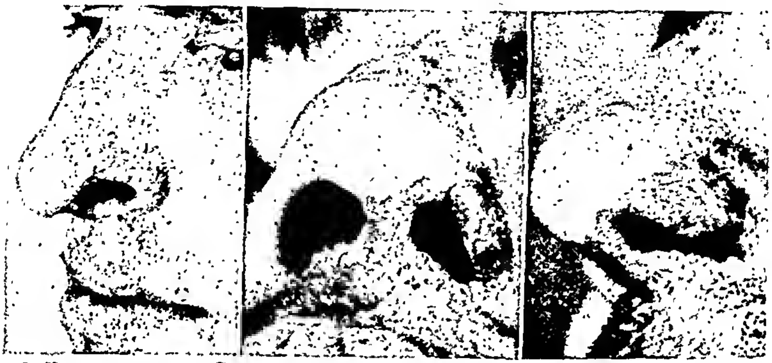


FIG. 2. RESTORATION OF COLUMELLA, TIP AND ALA IN SINGLE OPERATION BY USE OF A COMPOSITE FREE GRAFT OF SKIN AND CARTILAGE

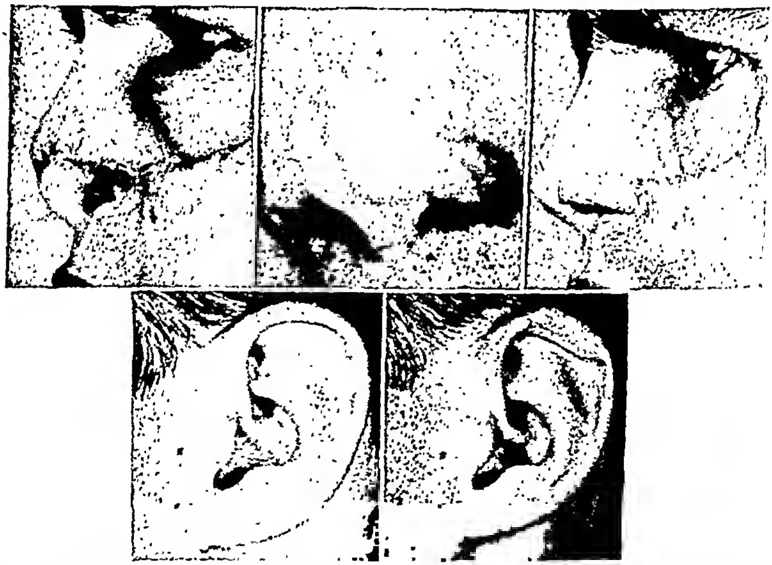


FIG. 3. LARGE REPLACEMENT OF MARGINAL LOSS OF NOSTRIL WITH FREE COMPOSITE GRAFT OF SKIN AND CARTILAGE. ADJUSTMENT OF DISTORTED TISSUE OF TIP COMPLETED BEFORE GRAFTING. REPAIR OF EAR WITH MASTOID FLAP

The graft is anchored to the nose with a few buried sutures and the skin closed accurately with fine stitches. A carefully applied dressing with packing in the nostrils for support and gentle resilient pressure externally is necessary for im-

mobilization. If a graft is discolored or blistered at the time of the first dressing, it will generally recover if kept dry and immobilized for several days.

These grafts have proved extremely useful in alar repairs by eliminating the need for deforming features of the face by use of local flaps, or of prolonging the repair in preparing remove flaps. The margin of the helix matches the mar-

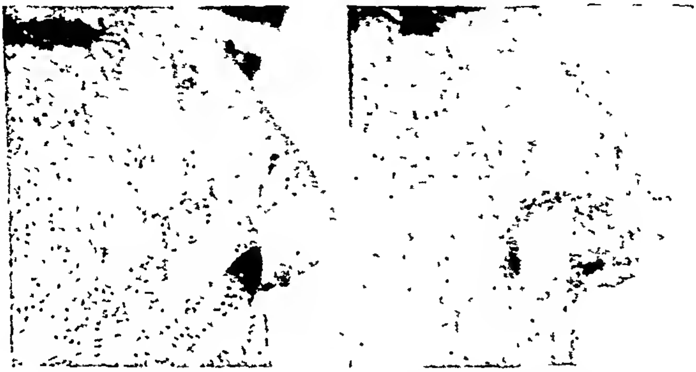


FIG. 4. ELONGATION AND ELIMINATION OF NOTCH IN NOSTRIL BY A WEDGE-SHAPED COMPOSITE FREE GRAFT OF SKIN AND CARTILAGE REPAIR OF EAR BY CLOSURE OF THE OPEN MARGINS

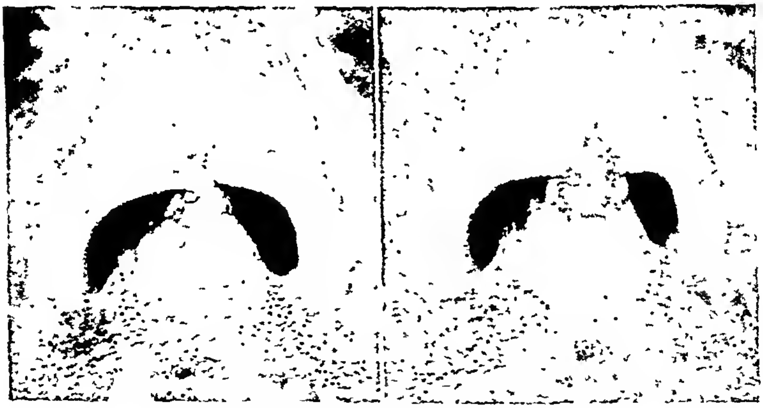


FIG. 5. RESTORATION OF TIP OF COLUMELLA WITH PLAQUE OF SKIN AND CARTILAGE. REPAIR OF EAR WITH SKIN GRAFT

gin of the ala remarkably well and the color matches almost perfectly Repairs of one ala, the tip, and columella have been carried out with a single graft reproducing the apex of the nostril. Bilateral losses of nostril borders have been done with tissue from the same ear. Short alae have been lengthened by opening the scar and inserting a wedge shaped graft. This report is based on experience

with over fifty cases of composite free grafts from the ear performed by the members of the plastic service. In only four cases has there been total loss of the graft.

SUMMARY

Further experience with the use of composite free grafts from the ear in columellar, tip, and nostril margin repairs confirm the initial enthusiasm for this method. A total of over fifty grafts have been performed with failure in only four instances.

REFERENCE

Brown, J. B., and Cannon, B.: Composite free grafts of skin and cartilage from the ear Surg., Gynec. & Obst., 82: 253–255.

FREE EAR LOBE GRAFTS OF SKIN AND FAT

Their Value in Reconstructions about the Nostrils[1]

S. M. DUPERTUIS, M.D., Commander (MC) USNR

Pittsburgh, Pennsylvania

Experience has shown that free cutaneous grafts for the purpose of correcting surface defects are best limited to the transplantation of various thicknesses of skin. Fat or other deeper structures attached to a large free graft most commonly results in failure of the procedure. Because of the color, texture and especially the contour of the ear lobe, we were attracted to this site as a source of tissue well suited for reconstructions about the ala, nasal tip and columella. These transplants are composite free grafts of the full thickness of the ear lobe, consisting of fat between two surfaces of skin. A total of 15 such grafts in 11 patients has been performed with success. The following is a presentation of the method illustrated by patients in this series of cases.

Free transplants of skin with some fat attached have been successful in thin strips of hair-bearing tissue for the replacement of eyebrows and eyelashes. Possibly rare instances of larger compound free grafts of skin and fat have been satisfactory, but such methods have been regarded generally as unsound. However, success occasionally rewards the prompt restoration of small completely avulsed portions of soft tissue. Aufricht (1) in 1944, in a survey of early plastic surgery in this country, referred to the satisfactory replacement of a completely avulsed ear lobe, by Pancoast in 1844.

The deliberate transplantation of a composite graft was reported by Joseph (2) in 1912, when he transferred a section of one normal ala to correct a defect in the opposite side. Using free grafts of skin and cartilage from the upper portion of the ear for alar reconstructions, König (3) recorded 47 operations of which 25 were successful, and Limberg (4) in 1935, likewise reported 47 composite free grafts with but six failures. Lately, Brown and Cannon (5) have illustrated graphically the value of these composite free grafts of skin and cartilage in reconstructions of the nostril border, tip and columella. One illustration was observed recently in Zeno's "Cirugia Plastica" (6) showing the repair of a nostril defect by a free graft of skin and fat from the ear lobe.

Quite independently and before our knowledge of previous work in this field, our interest was directed to the ear lobe as a possible source of grafts in reparative procedures about the nasal tip, alar borders and columella, since the ear lobe offers a readily adaptable contour and affords an excellent match in texture and color.

In planning the correction of a given defect, the approximate size and shape

[1]The opinion or statements contained herein are those of the writer. They are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

From U. S. Naval Hospital, Philadelphia, Pennsylvania.

of the desired transplant is measured on the lobe; the area selected is the straight portion of the lobe between the tail of the helix and the dependent curve (fig. 1d). After deciding upon the size of the graft needed, a triangular, wedge-shaped piece of ear lobe is excised under local anesthesia, and the resultant defect is then closed by laminated approximation of the cut edges (fig. 9c). This simple procedure

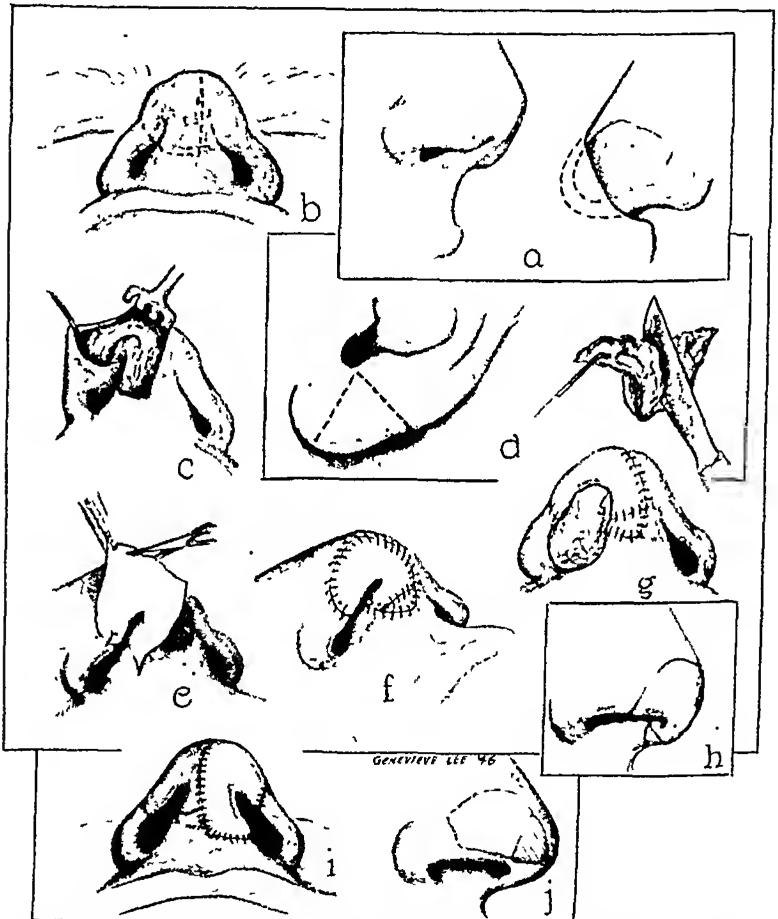


Fig. 1. The Reconstruction of a Nasal Tip Deformity with Free Ear Lobe Grafts of Skin and Fat; Illustrating Operative Steps of Case Shown in Figure 6

serves to correct the donor defect. Healing of the ear is prompt, with a minimal amount of scar and deformity (fig. 4b; figs. 5 and 6). Although we have not had occasion to employ larger sections, the entire lobe may be taken, if necessary, in which event a pedicle graft might be required to correct the resultant lobe deformity.

After the graft has been obtained, it may be tailored to fit the size and shape of the defect (fig. 1e), with care to place the graft preferably under normal skin tension inasmuch as no shrinkage has been observed in these transplants. In securing the graft in position with 6-0 silk, small skin sutures are placed to include some of the subcutaneous fat in each bite. In this manner buried sutures are not required although an occasional subcutaneous suture may be placed to maintain the position of the graft. Exact approximation of all edges, both cutaneous and mucosal, is desirable for satisfactory results. When the alar cartilage is intact, the ear lobe graft may be split to accept the cartilage edge, providing a thick surface covering and a thinner lining for the nostril (fig. 1d).

FIG 2A FIG 2B

FIG. 2A. Deformity of left nostril from loss of tissue at base of ala
FIG. 2B Repair with a free ear lobe graft of skin and fat

In larger defects about the nasal tip, it may be preferable to obtain a lobe transplant from each ear (fig. 6). However, these should be done as separate procedures; experience has shown that it is inadvisable to suture together two free grafts composed of skin and fat taken at the same time. This is understandable because a large portion of the blood supply of these transplants must come from their peripheral attachment to the normal adjacent tissues.

The technique of dressing deserves careful attention to insure gentle pressure and firm immobilization of the transplant As occasion demands, one or both of the nostril orifices is packed firmly with lubricated gauze and one thickness of xeroform gauze covers the graft smoothly. Over this, one layer of gauze compress is held in position by a carefully shaped stent mold immobilized rigidly by multiple strips of adhesive. The dressing is left undisturbed for 6 to 8 days.

At the time of first dressing most of these grafts have appeared pink and dry (figs. 5 and 6); only one was cyanotic when first seen and two had slight surface

Fig 3A

Fig 3B

Fig 3A Scar contracture at apex of right nostril
Fig. 3B. Removal of scar indicating size of surface defect, with triangular section of full thickness ear lobe graft shown on tip of nose.

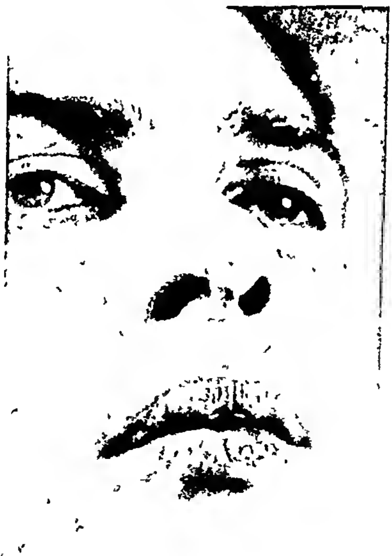


Fig. 3c Post-operative repair with free ear lobe graft.

erosion. In one case there was a localized area of necrosis where the two grafts, one from each ear lobe, were sutured together.

Usually secondary revision has been unnecessary but because these free trans-

FIG. 4A. (UPPER) Scar defect of left nostril.
FIG. 4B. (LOWER) Replacement with free graft taken from left ear lobe showing minimum scar deformity of donor site.

plants have their own subcutaneous tissue they may be undermined widely and, if indicated, contour grafts of derma or cartilage may be introduced (fig. 6).

After induration has disappeared, these transplants assume the normal softer consistency of the ear lobe and therefore are not as firm as the adjacent alar tis-

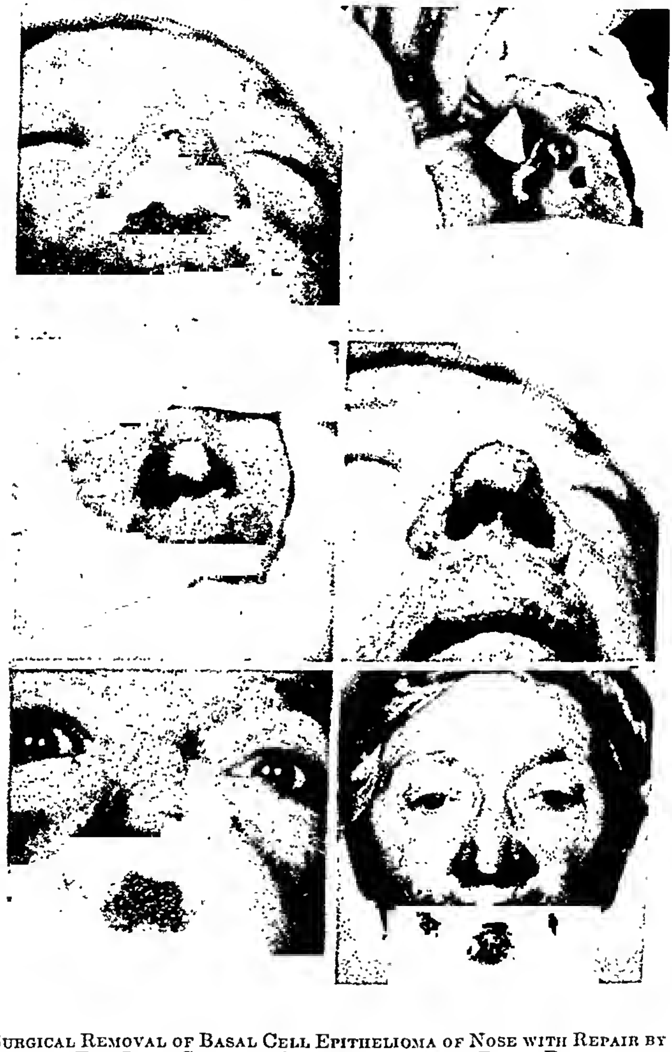


FIG. 5. SURGICAL REMOVAL OF BASAL CELL EPITHELIOMA OF NOSE WITH REPAIR BY A FREE EAR LOBE GRAFT OF SKIN AND FAT FROM RIGHT EAR

Appearance of transplant at operation (2 views), at first dressing on 7th post-operative day, and 9 months later. The match of skin texture and color is shown with final appearance of ear lobe.

sue. The excellent match of surface texture and color of these grafts to the nasal skin is demonstrated well in figure 5.

There is a variety of applications for these free ear lobe transplants about the borders of the nares. When only a small triangular section of graft is required to

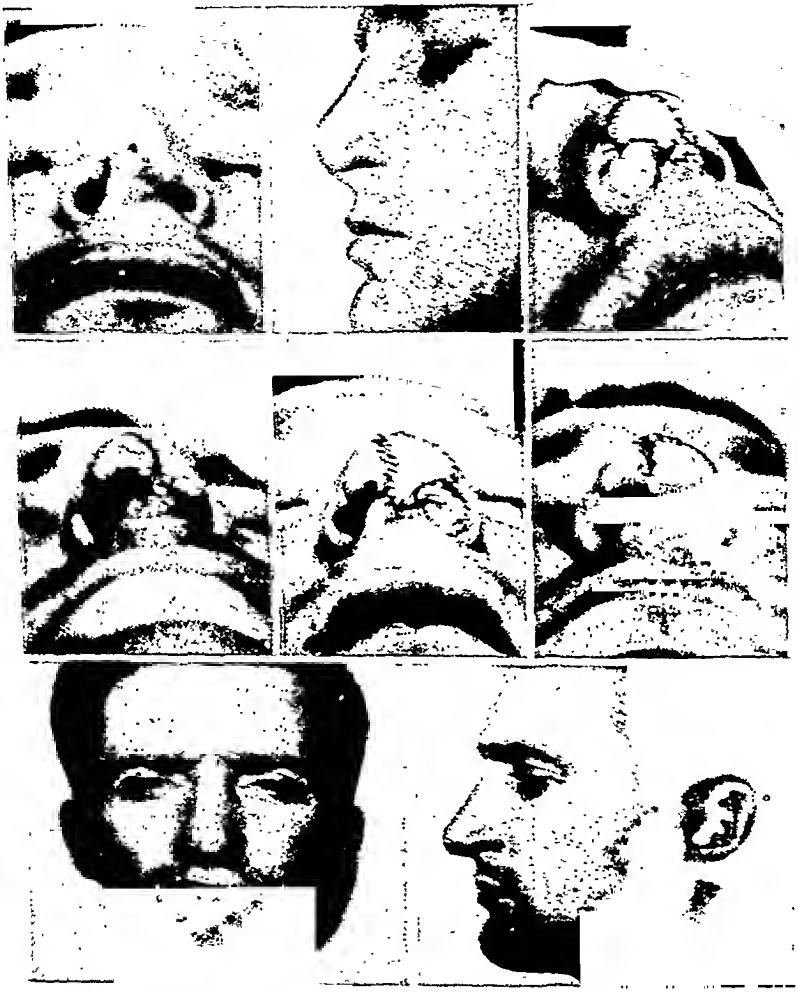


Fig. 6. Scar Deformity of Nasal Tip with Loss of Tissue; Reconstruction by 2 Free Ear Lobe Transplants, One from Each Ear, in Separate Procedures

Each graft sutured in position is shown at operation and on 7th post-operative day, with final result after insertion of a contour cartilage graft. Minimal deformity of ears by simple closure of donor defect.

correct a full thickness defect of the ala, a large attached flap of skin and subcutaneous fat from the posterior surface of the lobe may be obtained also to re-

place adjacent dense scar defects (fig. 7). In larger graft insets when support is required, a small section of ear cartilage, secured from the concha, can be in-

FIG. 7A FIG. 7B FIG. 7C

FIG. 7A. Partial atresia right nostril with dense surrounding scar.
FIG. 7B. Operative defect through the ala with removal of adjacent dense scar. Ear lobe graft shown above.
FIG. 7C. Appearance of graft at time of first dressing on 7th post-operative day.

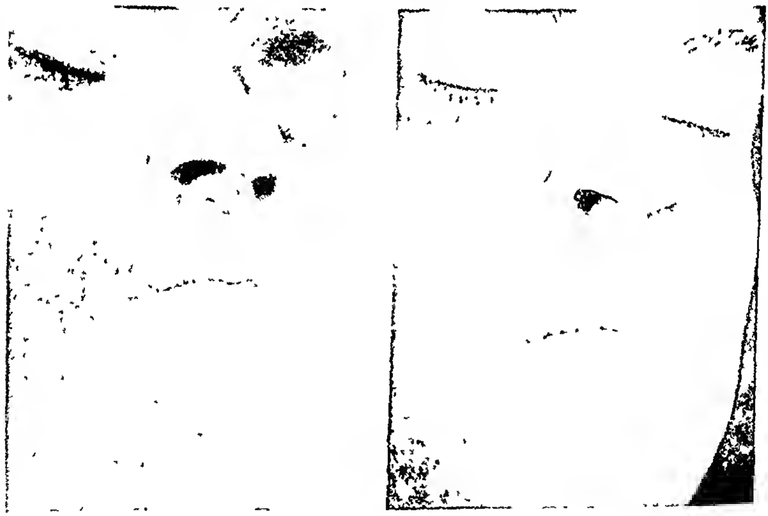


FIG. 8A FIG. 8B

FIG. 8A. Scar defect at base of right ala with depression of floor of nostril.
FIG. 8B. Repair of ala and floor of nostril with free ear lobe graft of skin and fat.

serted. An ear lobe graft can reproduce the rounded curve of the base of the ala as it forms the floor of the nostril when this area is deficient following traumatic loss or cleft lip repair.

By means of the technique described, numerous defects about the nose can be corrected in a single operation with free grafts of ear lobe tissue and in many instances they may replace, with improved results, the more time-consuming

FIG 9A

FIG 9B

FIG 9A Second recurrence of basal cell epithelioma at edge of depressed previous skin graft
FIG 9B Wide removal with repair by an interpolated naso labial flap

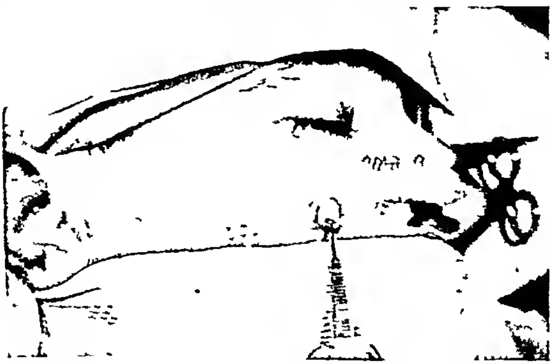


FIG 9C Operative removal of nostril border following pathological report of remaining tumor tissue Revision of original flap and transplant of ear lobe shown, with simple repair of donor site by approximation

method of pedicle graft reconstruction For example, the insertion of a triangular portion of ear lobe may provide a simple direct solution to the problem of columella lengthening in cases of bilateral cleft lip Likewise these grafts

permit the immediate reconstruction, in one procedure, of defects following surgical excision of skin malignancies near the nostril border (figs. 5 and 9). Probably further applications of free ear lobe grafts of skin and fat will be reported, but in particularly they have proved of great value in reparative surgery about the nostril because of their contour, color and surface texture.

Fig. 9d. Two weeks after final revision following nostril border repair with ear lobe graft.

SUMMARY

The use of free ear lobe grafts of skin and fat in the reconstruction of defects about the nose is described. These free transplants are especially suited because of shape, color and surface texture for use about the nostrils. The simplicity of closure of the triangular donor defect with minimal scar deformity is an important consideration. Free ear lobe grafts have been employed with success in reconstructions of the nasal tip, alar border, columella, floor of the nostril and small adjacent areas of deep surface scar.

REFERENCES

1. Aufricht, G.: Tr. Am. Soc. of Plastic and Reconstructive Surg., 1944, pp. 9–32.
2. Joseph, J.: "Handbuch d. Speiziellan Chir." Katz, Preysing, Blumenfeld, 1912.
3. Konig, F.: Brun's Beitrage z. klin. Chir., 1914, Bd. xciv; 515.
4. Limberg, A. A.: Sovet. khir., 9: 70–90, 1935.
5. Brown, J. B., and Cannon, B.: Surg. Gyn. Obst., 82: 253, 1946.
6. Zeno, Lelio, "Cirugia Plastica", Buenos Aires, 1943.

THE PUSH-BACK OPERATION FOR REPAIR OF CLEFT PALATE

G. M. DORRANCE, M.D., AND J. W. BRANSFIELD, M.D.

The "push back" operation first devised for congenital insufficiency of the palate has been employed by us for twenty years in the treatment of all varieties of cleft palate. During this time many minor changes have been made but the main idea behind the procedure has remained unchanged.

We have seen cases operated on by at least twenty different surgeons employing our method with or without modifications and feel we are now in a position to evaluate the final results obtained.

Despite the fact that we have never seen a "flap" lost where the method employed followed our recommendations, we are constantly receiving inquiries as to whether or not the posterior palatine arteries should be divided. Many surgeons insist on saving the vessels.

Many surgeons who use the principle of the "push back" do not advise or use skin grafts to line the under surface of their flaps.

The purpose of this paper is to give the indications for this operation, the operative details and to attempt to show the necessity for following out the various steps advised.

TYPE I. CONGENITAL SUBMUCOSAL OR CONGENITAL INSUFFICIENCY OF THE PALATE AND CLEFT OF THE SOFT PALATE

The shortening in these types of cleft palate is almost invariably due to a deficiency of the horizontal plate of the palate bone (fig. 1). Since the soft palate is attached by the palatine aponeurosis to the shortened horizontal plate, the shortening is in direct proportion to the bony deficiency. Obviously, the simple repair of any cleft in the soft palate cannot have the slightest effect in accomplishing velopharyngeal closure.

We advise, and routinely carry out, the following procedures: (1) We attempt to find the amount of bone deficiency by the insertion of a needle at various points, as shown in figure 2. Figures 3 and 4 show normal bone and the loss of bone in submucous cleft cases. (2) In all cases, we perform the two-stage "push back" operation.

First stage of the "push back" operation

The first stage consists of raising the flap by Method A, figure 5, or B, figure 9. Method A is selected if we are dealing with a fairly normal, well-developed flap with adequate blood supply. In these cases, the palatine vessels are divided.

It is next to impossible to obtain the necessary lengthening of the palate without cutting the posterior palatine vessels. If, as Brown suggests, the vessels are exposed and pulled out, lengthening is obtained, but if sufficient lengthening is obtained, the vessel must of necessity be acutely kinked.

If you note in figures 6 and 15, the extent of raw surface which will result if the skin graft is omitted you can readily see that some puckering and thickening must

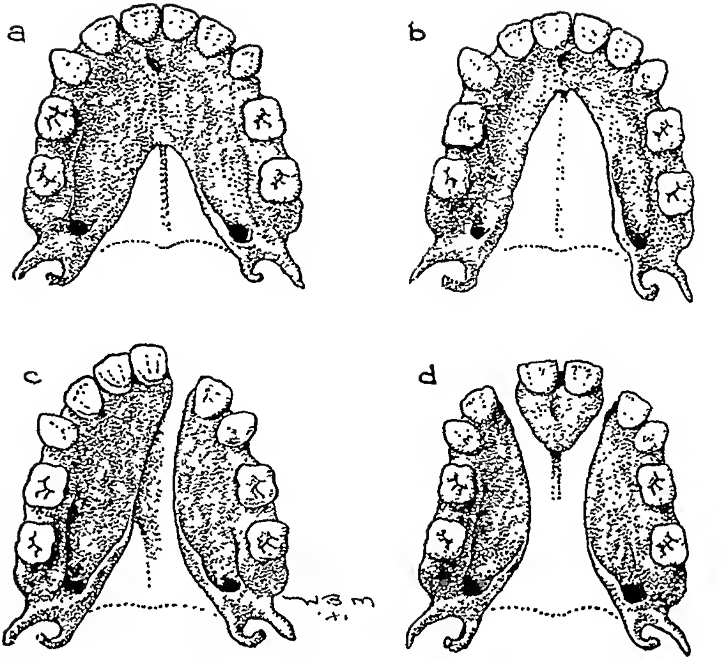
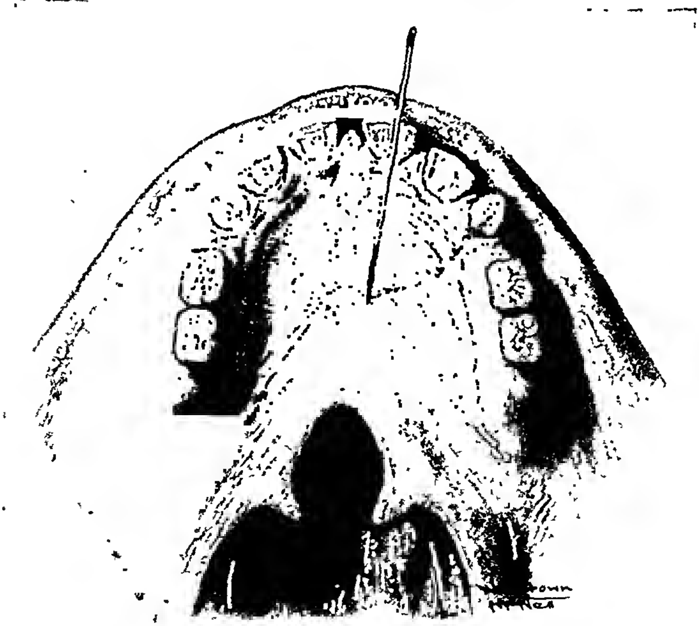


FIG. 1. DEFICIENCY OF THE BONE IN DIFFERENT VARIATIONS OF CLEFT PALATE



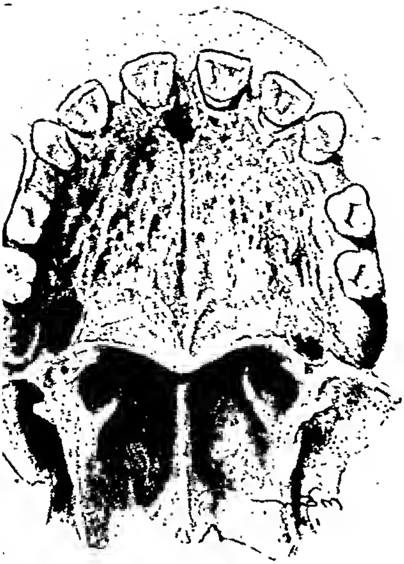


Fig. 3

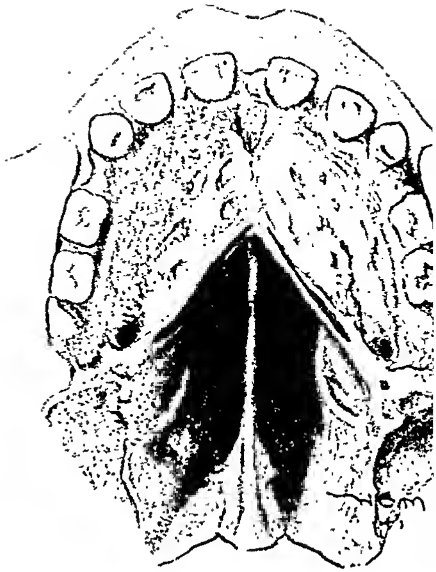


Fig. 4

Fig. 3. Normal Bones in the Palate
Red border indicating where the palatine aponeurosis should be attached

Fig. 4. Note the Loss of Bone in a Submucous or Cleft of the Soft Palate
Rough area is where aponeurosis would be retracted to, thus shortening the palate

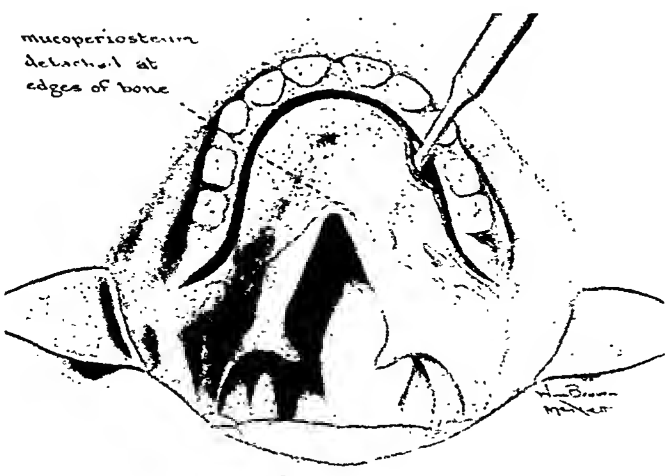


Fig. 5. Method A—for Elevation of the Mucoperiosteal Flap

result. This militates against obtaining a good soft resilient palate so essential for proper speech.

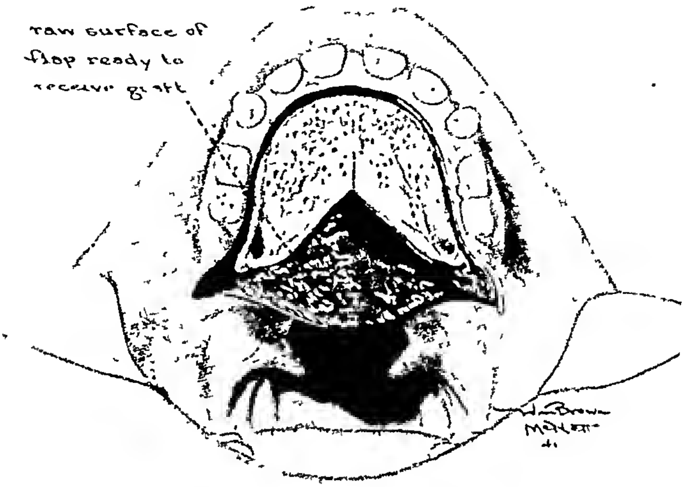


FIG 6 FLAP ELEVATED—VESSELS DIVIDED READY FOR SKIN GRAFT

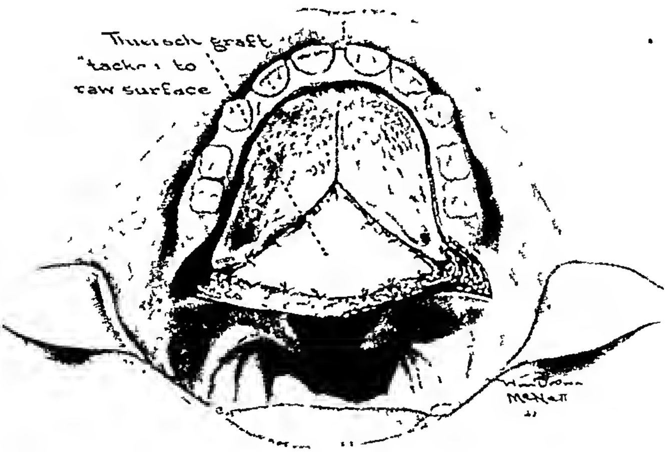


FIG. 7. FLAP ELEVATED—SKIN GRAFT SUTURED IN PLACE

When the flap is raised, a skin graft is sutured in place on the palatine mucoperiosteum, as shown in figures 6, 7, and 8. The flaps are returned to their bed

and the edges sutured. In some cases where the palatine mucosa is thin, or where a considerable bony defect is present, or where the blood supply does not appear

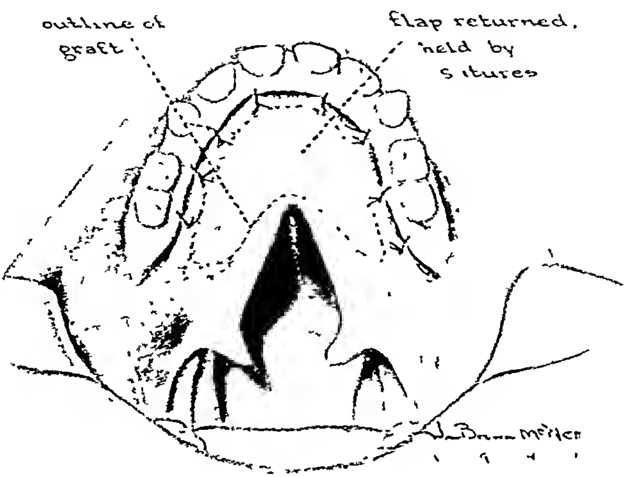


FIG. 8. FLAP WITH SKIN GRAFT RESUTURED IN PLACE

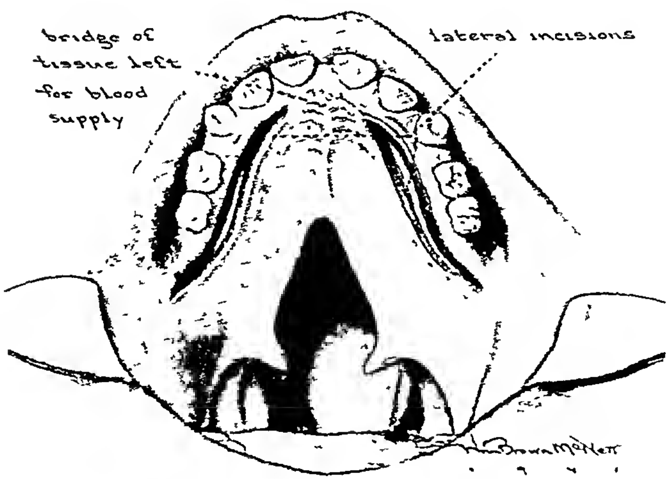


FIG 9. METHOD B—FOR ELEVATION OF THE MUCOPERIOSTEAL FLAP

to be adequate, Method B is employed (fig. 9). In those cases, the palate is raised, leaving a bridge of undivided tissue to insure blood supply. The remain-

ing portion of the flap is freed completely from the bone and the palatine arteries are divided, as in Method A. The flaps are then sutured back in their normal position.

We have noted that the flaps thicken appreciably following this procedure. If, when the second stage is being performed, we find the flaps are not of sufficient thickness, we raise them and again replace them and wait for another four or ten weeks before elavating and placing the skin grafts, after the method outlined above.

We deliberately avoid using the nasal mucous membrane, because in performing the second stage of the "push back" operation it is necessary to divide the nasal mucous membrane and aponeurosis at its attachment to the bone, thus

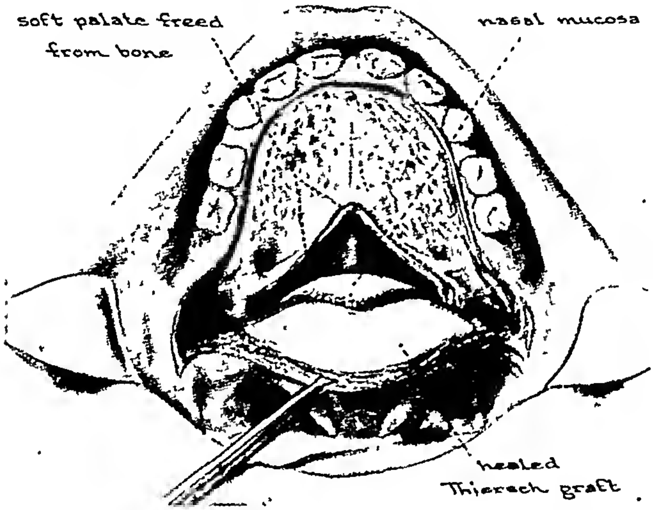


Fig. 10. Flap Elevated Showing a Successful Skin Graft in a Cleft of the Soft Palate

leaving a raw area. If the nasal mucous membrane is not divided, complete velopharyngeal closure will not be obtained in many cases because the muscles responsible for this closure will not be restored to their normal position.

Second stage of the "push back" operation

A flap is raised through the former incision, the nasal mucous membrane being divided from the posterior bony palate (fig. 10). The hamular process is then divided, thus transposing the tensor palati muscle from a tensor to an elevator muscle. The incision is continued around the tuberosity of the maxilla and over the pterygomandibular fold, freeing the palate from all bony attachments.

The uvula now rests on the posterior pharyngeal wall. The anterior portion of the flap is sutured to the fibrous membrane at the apex of the defect, and is also immobilized by passing one or two aluminum-bronze wires first through the

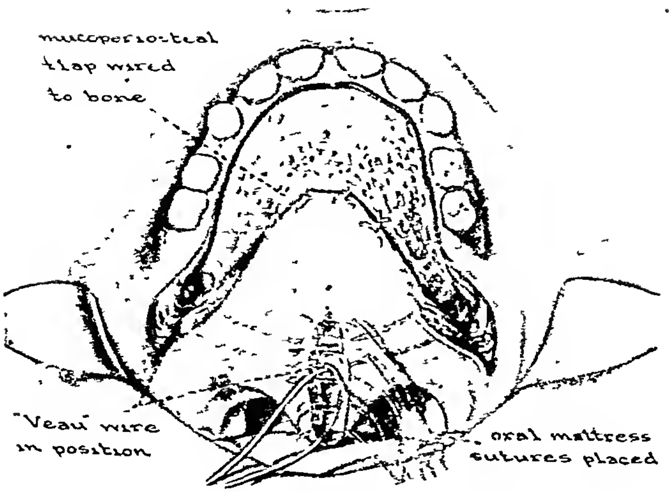


FIG. 11. FINAL STAGE OF THE "PUSH-BACK" OPERATION IN CLEFT OF THE SOFT PALATE

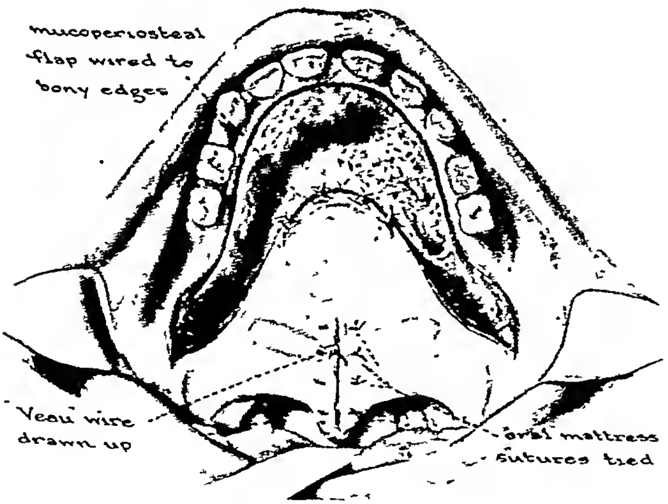


FIG. 12. FINAL STAGE OF THE "PUSH-BACK" OPERATION

bony palate, then through the apex of the flap on either side of the midline. Each wire is then twisted until the flap is held securely; the ends of the wire are then bent back, thus preventing any injury to the flap and tongue (fig. 11).

The bony palate and lateral sulci, now devoid of their covering as a result of the push back operation, are covered and packed with iodoform gauze, which is held in place by a Gross Splint (figs. 20, 21, 22, and 23). The gauze is allowed to remain in place 10 to 14 days.

A summary of the necessary steps involved in the correction of congenital insufficiency of the palate follows:

Method A: 1. Raise the flap and suture the skin graft in place. 2. Three to ten weeks later, perform the "push back" operation. *Method B:* 1. When the viability of the palatal tissue is uncertain, a three-stage operation should be performed. First raise the palatal flap, divide the palatine vessels, and suture the flap back in place. 2. Six to eight months later, raise the flap through the original incision and insert the skin graft. 3. Three to ten weeks later, complete the repair with the "push back" operation.

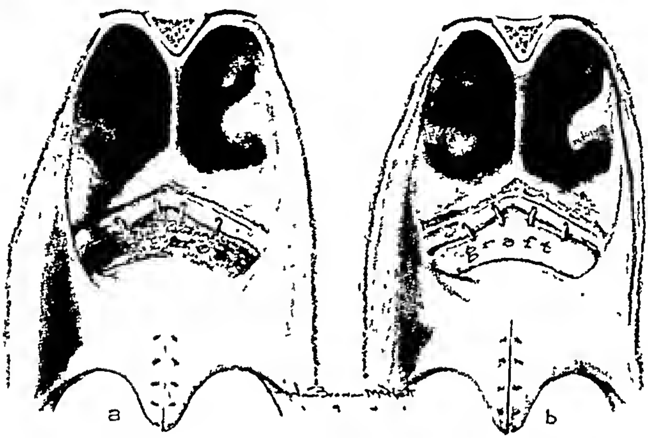


FIG. 13. NASAL SURFACE AFTER THE "PUSH-BACK" OPERATION
(a) Without skin graft. (b) With skin graft in place

TYPE II. CLEFT OF THE SOFT PALATE

This group of defects presents not only a short or insufficient palate but, in addition, a cleft of the soft palate (fig. 2). The operation of choice is the two-stage "push back" operation.

The second stage of the "push back" operation is now accomplished by raising the flap, dividing the hamular process on either side, severing the connections of the soft palate from the nasal surface of the bony palate. In this way, the nasal mucous membrane and the aponeurosis are separated from the posterior border of the hard palate (fig. 10).

The next step is to denude the edges of the cleft and approximate the nasal

mucous membrane of the two halves, with interrupted sutures (left untied) (fig. 11) It will be found helpful to insert a few mattress sutures to evert the edges

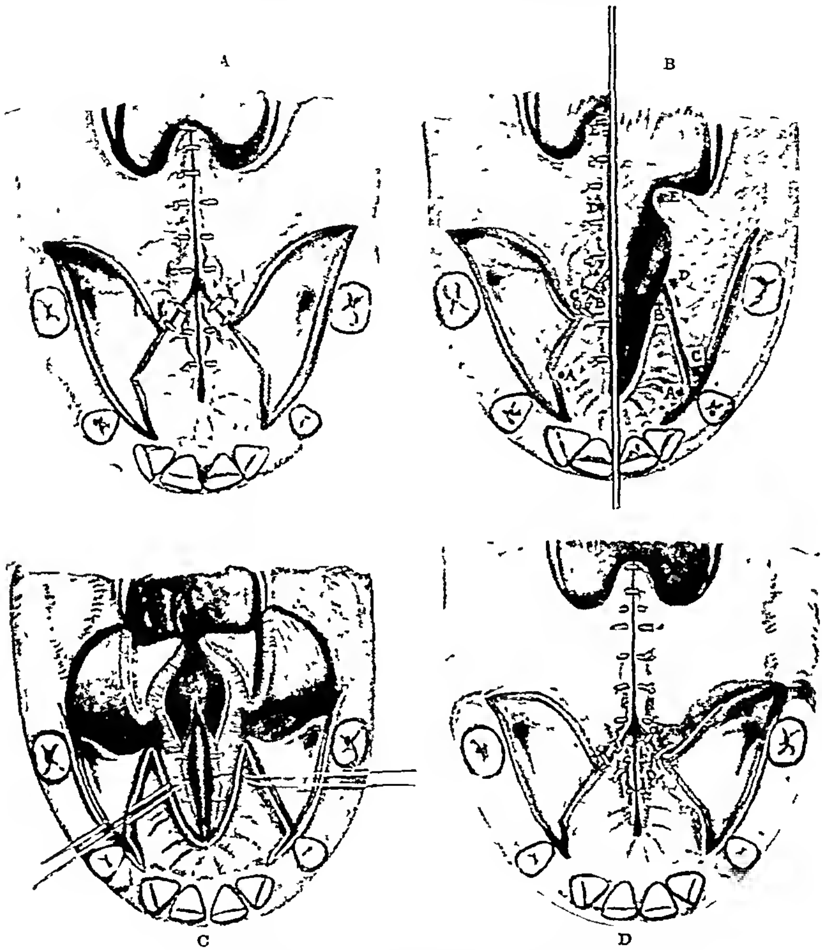


FIG 14 WARDILL'S METHOD OF OPERATION

(A) Completion of the suture line (B) Illustrated diagramatically how, by cutting flaps in the method described, a form of VY advancement of the velum takes place. The letters indicate corresponding positions before and after operation (C) The mucosa from the nasal surface of the hard palate is united to the vomerine mucosa The situation of the stay sutures is shown (D) Repair completed The dotted line shows the approximate of the united nasal mucosa. (British Journal of Surgery 25. 1937).

and prevent inversion of edges—a frequent cause for nonunion. One or two Veau sutures are next placed through the muscular layer at the middle third of the soft palate We use a specially designed needle for placing this intramuscular

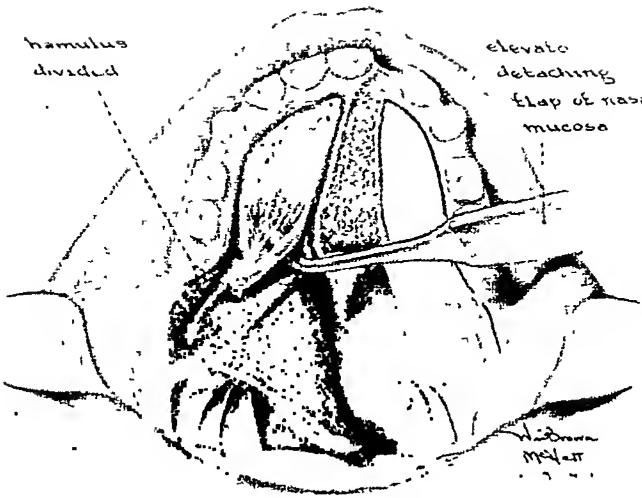


FIG. 15. ELEVATION OF FLAPS IN PREPARATION FOR SKIN GRAFT IN SINGLE LIP-JAW PALATE CLEFT
Note how a portion of the nasal mucous membrane may be elevated

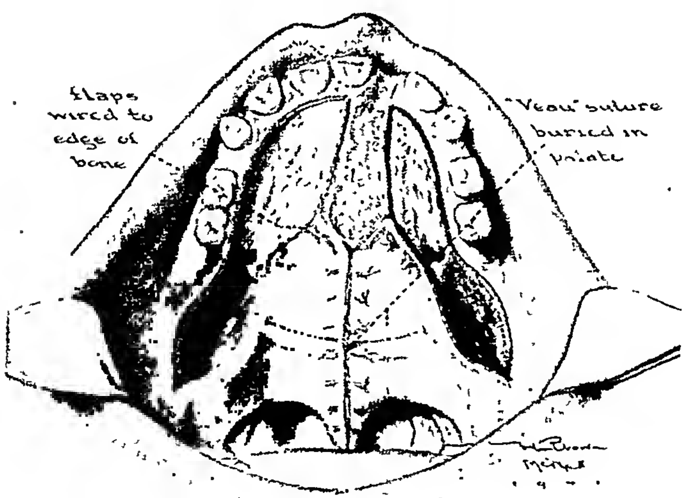


FIG. 16. COMPLETED SECOND STAGE OF THE "PUSH-BACK" OPERATION IN SINGLE, COMPLETE LIP-JAW PALATE CLEFT

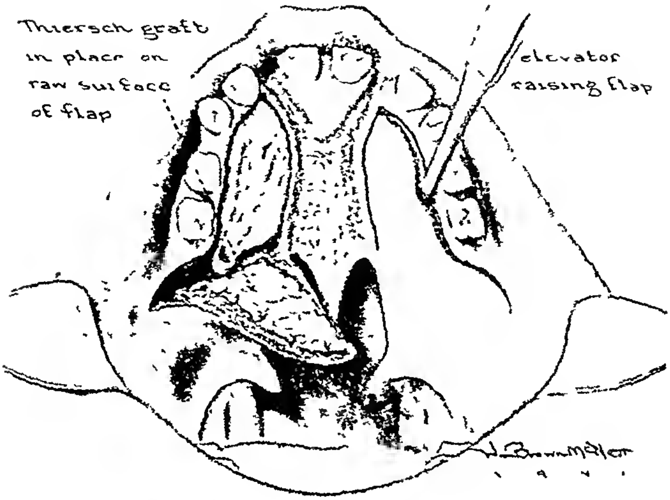


FIG 17 RAISING OF FLAPS AND SKIN GRAFTING IN FIRST STAGE OF THE "PUSH-BACK" OPERATION

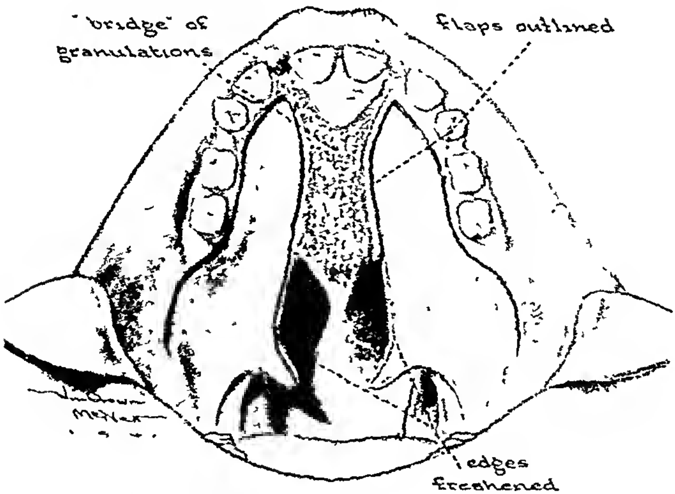


FIG 18. INCISION FOR FLAPS IN THE FINAL STAGES OF THE "PUSH-BACK" OPERATION

suture, bringing it from the midline out through the lateral incisions, as shown in figures 11 and 12, and ending in midline. These needles—straight or curved—with wire sutures attached, are prepared for us by the Davis and Geck Co. The

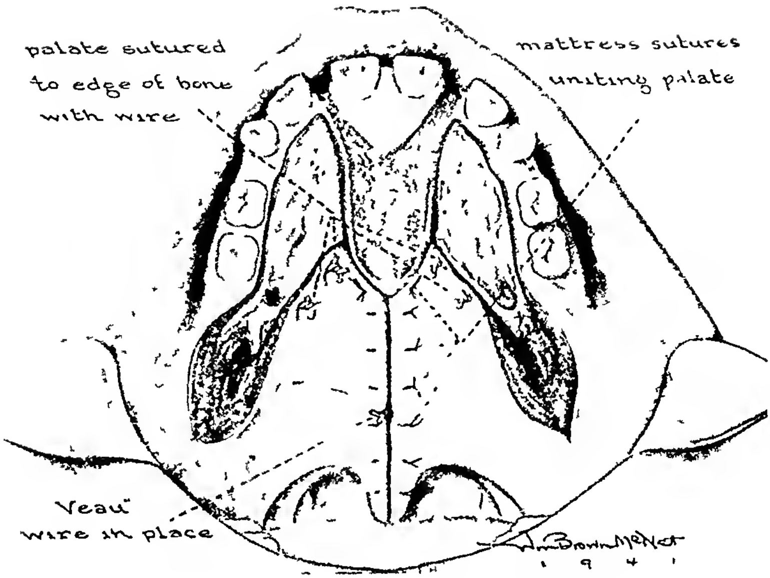


FIG 19 DEMONSTRATING THE COMPLETION OF THE FINAL STAGE OF THE "PUSH BACK" OPERATION IN DOUBLE CLEFT PALATE

FIG 20 GROSS SPLINT

suture is placed and left untied; the nasal sutures are tied, closing this surface, with the edges everted.

Fig. 21. Gross Splint

Fig. 22. Gross Splint

The Veau suture is now twisted (tied) bringing the two halves of the cleft into good approximation, without tension. The oral sutures are next inserted and tied. These sutures should pass down to, but not through the nasal mucosa. Ordinary through-and-through sutures, if not carefully laid and tied, will invert the edges of the mucous membrane. Use end-on-end mattress sutures. The

anterior end of the flap is now sutured to the palate bone or to the fibrous tissue present. An iodoform pack is placed over the uncovered palate and in the lateral incisions and a Gross Splint applied (figs. 20, 21, 22, and 23).

The raw nasal surface that formerly existed in the "push back" operation is avoided by the use of the skin graft (fig. 13). Tension sutures, or metal plates, used to reduce tension will frequently produce a permanent scar. Intramuscular and intrafascial sutures are well tolerated and, for this reason, the Veau suture is ideal. We use it in all cases. The mattress suture is well tolerated because it

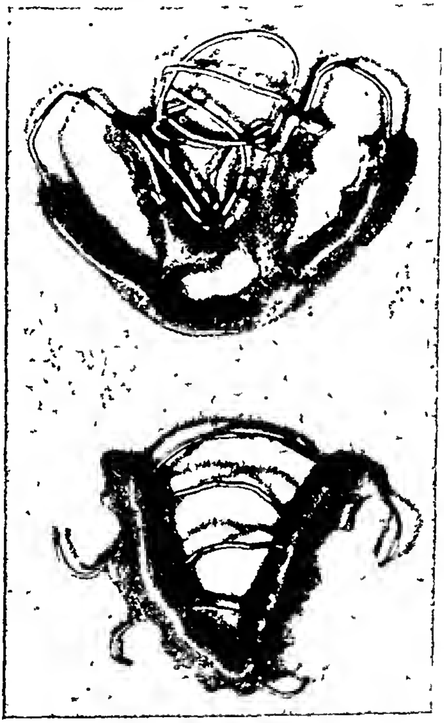


Fig. 23 Gross Splint

gives maximum approximation of the two muscular segments with epithelial or surface tissue compression.

A summary of the operative procedure in this type is: 1. Raise the flap and suture a skin graft in place. 2. Three to ten weeks later, the "push back" is completed.

If the palatal tissues do not warrant extensive surgery at this time, a three-stage procedure should be employed:

First stage: Raise the flap, sever the palatine vessels and suture back in place.

Second stage: Six to eight months later, raise the flap through the original incision and insert the skin graft—resuture.

Third stage: Three to ten weeks later, perform the "push back" operation.

TYPE III. CLEFT OF THE SOFT AND HARD PALATE UP TO THE PREMAXILLA

This group presents four distinct variations: 1. The defect in the palate bone may be as wide as the cleft in the soft palate. 2. The margins of the soft cleft may converge anteriorly into the narrow cleft of a very poorly developed hard palate, with its characteristically high narrow arch. 3. The vomer may be fairly well developed or only rudimentary.

In our experience, the vomer is usually rudimentary and does not approach the level of the defect. These variations affect the type of operative procedure. The presence or absence of a normal vomer is the most important factor present. When the vomer is rudimentary, as is usual in this type of cleft, it plays no part in the correction. The Langenbeck lateral incision may be made, the flaps raised and the skin grafted in one operation. Three weeks later, the Langenbeck operation is performed closing the cleft. Six months later, the V-"push back" operation is performed.

The Wardill operation uses the Veau-method of stretching the mucous membrane and covering it with V-flaps, much the same as we do in the V-"push back." If the vomer is well developed, we perform the "push back" as described in Type V.

The practicability of the Veau idea of reflecting the nasal mucous membrane must be considered. When the arch is high and narrow, the mucous membrane is difficult if not impossible to transfer. When closure is obtained in this type, it is not entirely satisfactory. In a limited number of cases where the cleft is not too wide or the arch is not too high, it is possible to elevate sufficient nasal mucous membrane from the floor of the nose to suture it in the midline. It has not been entirely satisfactory for us. We feel, however, that the skin graft reduces the possibility of tissue failure to a minimum and preference is made of its use.

TYPE IV. SINGLE COMPLETE CLEFT OR UNILATERAL LIP-JAW PALATE SPLIT

When conditions permit, the lip is closed soon after birth. This produces a fusion of the alveolar cleft. Rarely, in this type, is the vomer rudimentary. As a rule, it is well developed and attached to the longer side and its mucoperiosteum can be used to close off the nasal chamber.

In the presence of a well developed vomer, lying on a plane and articulating with the palatal process, its mucosa may be separated from the bone and reflected like the open page of a book. This leaves the vomer devoid of its mucosal covering. The palatal mucous membrane on the short side is elevated one-quarter inch along the margin of the cleft and the vomer flap is tucked into this recess. This brings the two raw surfaces into contact in which position they are immobilized with mattress sutures. The triangular cavity thus created is packed with iofoform or xeroform gauze, and held in place by a Gross Splint for at least ten

days (figs. 20, 21, 22, and 23). This area granulates progressively to the surface effectively solidifying the anterior third of the palate (figs. 24, 25, 26, 27, and 28).

The operative sequence for correction in the presence of a well developed vomer is as follows: About the second or third year or later, the vomer flap is reflected as described and the area allowed to fill in. In from five months to two years later, a first of a two-stage "push-back" operation is performed. This consists of a long lateral incision on either side; the posterior palatine vessels are divided and the flaps raised (fig. 15). If they blanch or are very thin, we immediately suture them back in place. Three to ten weeks later, the "push-back" operation is performed. The flaps are elevated with their adherent skin grafts, carried

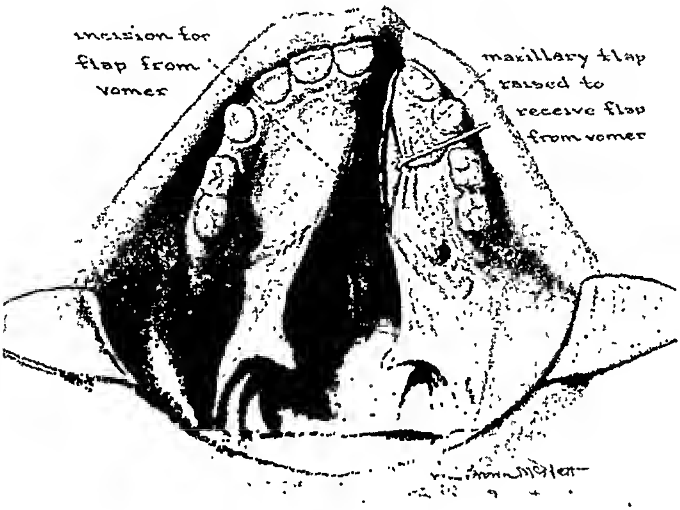


Fig. 24. Incision of the Vomer Flap

backward and fixed. The pattern of this reconstructed palate resembles that of Smith, Ganzer, Halle-Ernst, Limberg and Wardill (fig. 16).

It should be noted here that the filled-in area, bounded by the vomer flaps, remains untouched. Incisions for the "push back" flaps are made only when the bony palate has been unmistakably outlined with a needle. This gives a bony floor for the flaps on either side of the vomer area and the "push-back" operation is completed essentially the same as previously described.

To summarize briefly: The vomer flap is raised and sutured "leaf-of-the-book-wise" to the opposite palatal flap. The space formed is packed and allowed to granulate to the surface. We strongly stress this phase of the operation, because the anterior part of the hard palate has automatically repaired itself without disturbing any of the palatal tissue.

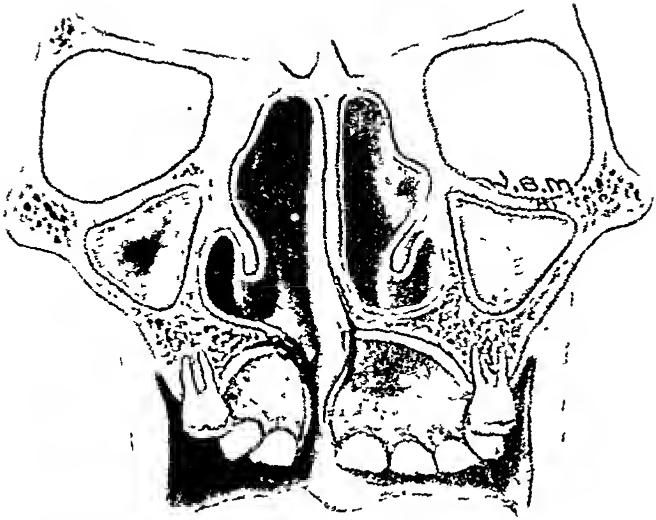


Fig 25 Transverse View of the Incision and Elevation of the Flaps from the Vome

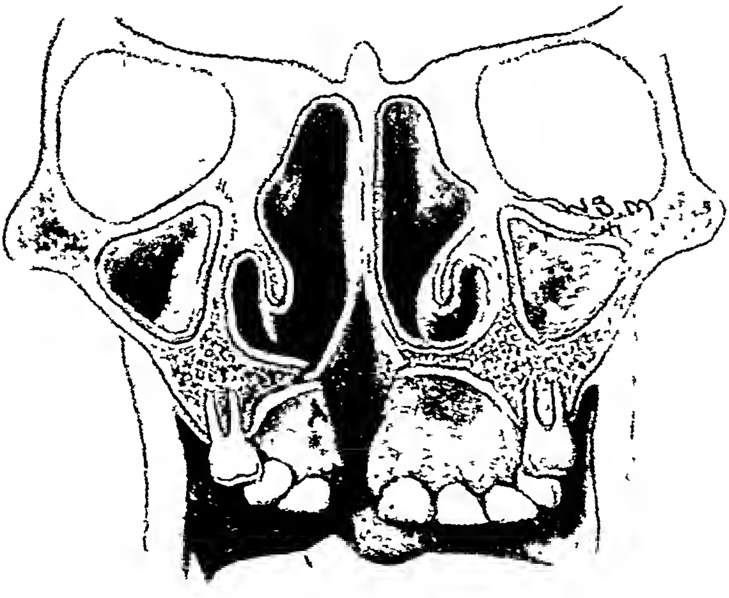


Fig 26 Transverse View of the Completed Vomer Flap

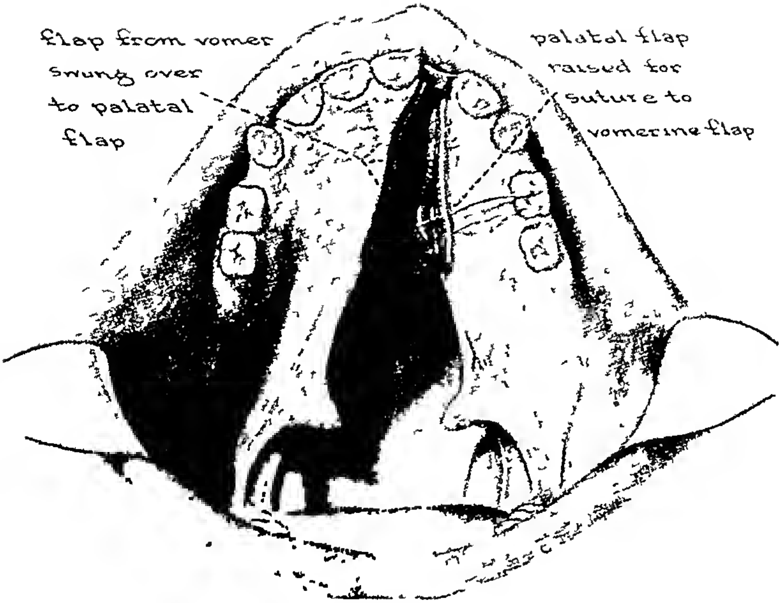


Fig 27 Suturing of the Flap in the Vomer Transplantations

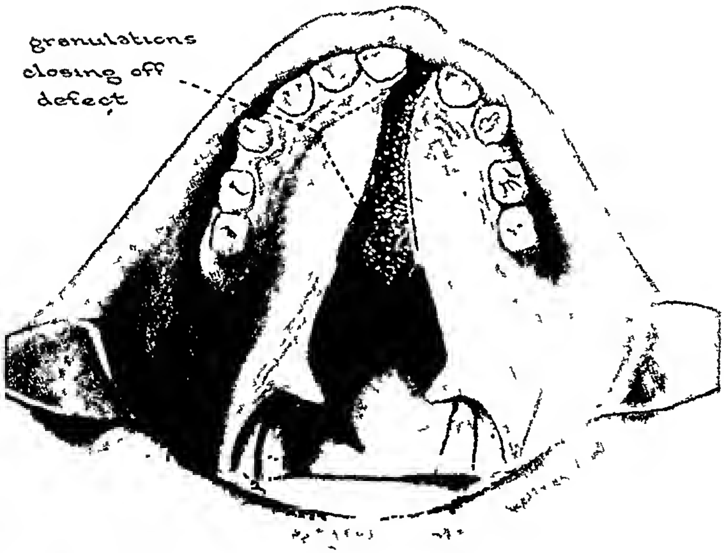


Fig 28 Completed and Filled in Vomer Flap Operation in Single Lip Jaw Palate Cleft

Five months after the vomer-mucoperiosteal transplant, the tissue in this area is usually well organized and the flaps may be elevated and skin graft inserted. Three to eight weeks later, the "push back" operation is performed. The order of the repair is as follows:

1. The nasal sutures are inserted but not tied.
2. The Veau suture is inserted but not tied.
3. The nasal sutures are now tied.
4. The oral sutures are inserted but not tied.
5. The Veau suture is now tied by twisting the ends, thus approximating the two halves.

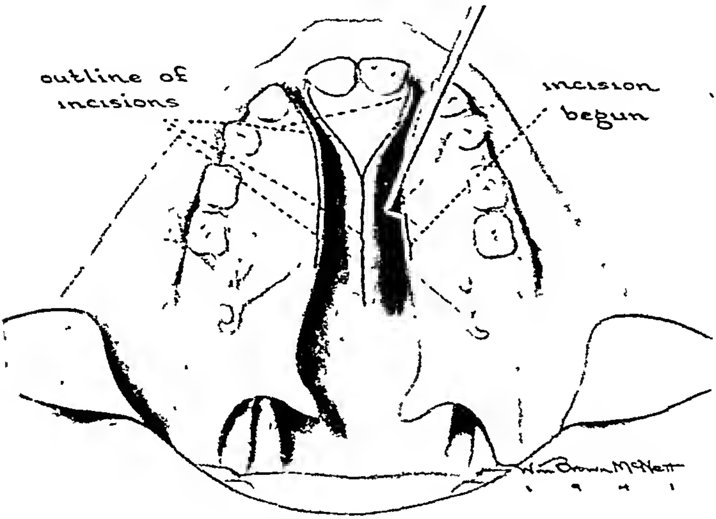


FIG 29. LINES OF INCISION FOR BILATERAL VOMER FLAPS IN A DOUBLE LIP-JAW PALATE CLEFT
Note how far forward they may be placed

6. The oral sutures are now tied.
7. Retroposition is effected, and the palate is anchored in its new position with the wire sutures as previously described.

The bony palate is covered with iodoform gauze, and the latter is held in place with silver wire to permit granulation across this space.

The unilateral lip-jaw split, with a rudimentary vomer, is rare, but in such cases the repair may be made by either of two methods:

1. The Langenbeck operation is performed as a preliminary step, with or without a skin graft, as conditions warrant.
2. Use the method of Ganzer, modified by Limberg, and popularized by Wardill (fig. 14).

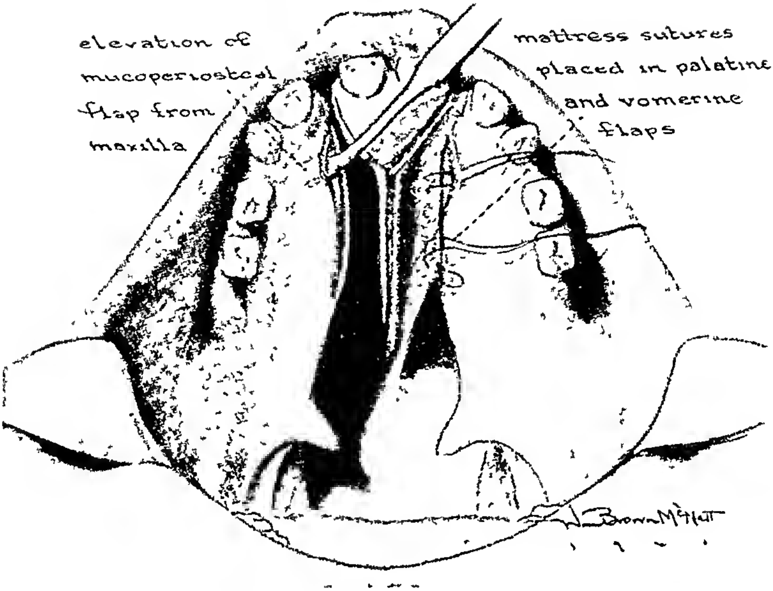


FIG. 30. DEMONSTRATING THE METHOD OF ELEVATING AND SUTURING THE VOMER FLAP IN DOUBLE LIP-JAW PALATE CLEFT

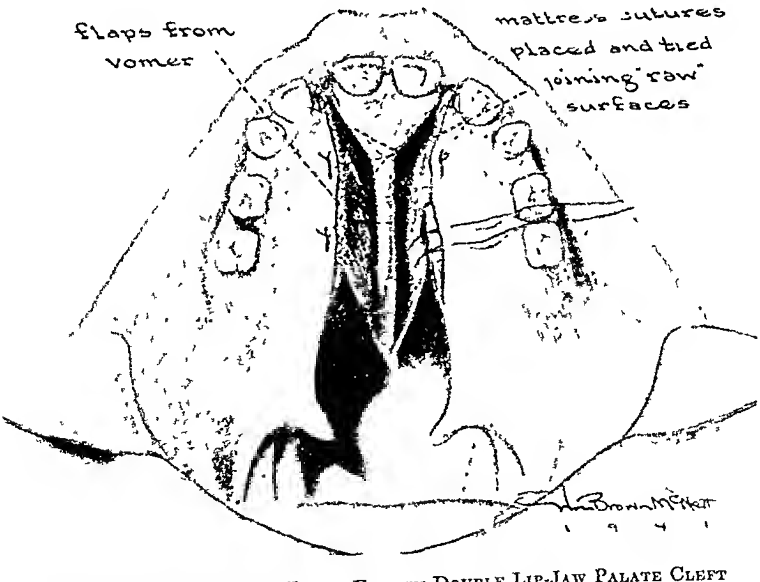


FIG. 31. COMPLETED DOUBLE VOMER FLAP IN DOUBLE LIP-JAW PALATE CLEFT

We prefer the Langenbeck method of anterior closure followed by the V-"push back" operation.

If the flaps permit, the grafts are inserted at the same time the palatal mucous membrane is raised. If, on the other hand, the tissue is very thin and blanches, a three-stage operation is automatically resorted to in completing the Langenbeck procedure. Since a short palate now exists, the V-"push back" operation

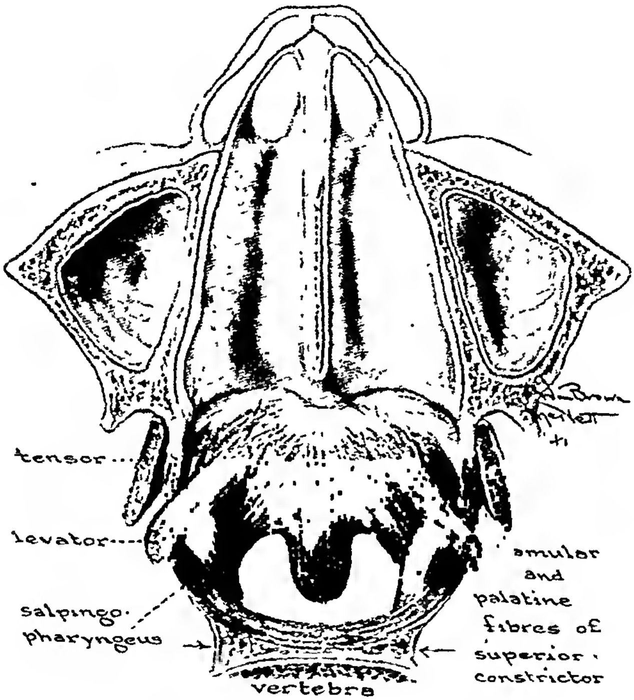


FIG. 32. DEMONSTRATING THE POSITION OF THE SUPERIOR CONSTRICTOR AT REST
Note the palatine fibers of the superior constrictor which cause the shut-off

is performed, much the same as shown in figure 16, to obtain velopharyngeal closure.

TYPE V. DOUBLE COMPLETE CLEFT OR BILATERAL LIP-JAW PALATE SPLIT

The method of closure is by reflecting of one or both vomer flaps of mucous membrane outward as the open pages of a book (figs. 29, 30, and 31). It is easier to do this bilaterally at once, and not in stages. Some authors believe there is danger of losing the vomer if this is done. However, our experience has not borne this out.

Upon the first examination of a cleft palate, soon after birth or in infancy, the vomer may appear to be only a remnant. A year or so later, one is often surprised to note that, in many cases, the vomer has developed to a point where the flaps may be utilized.

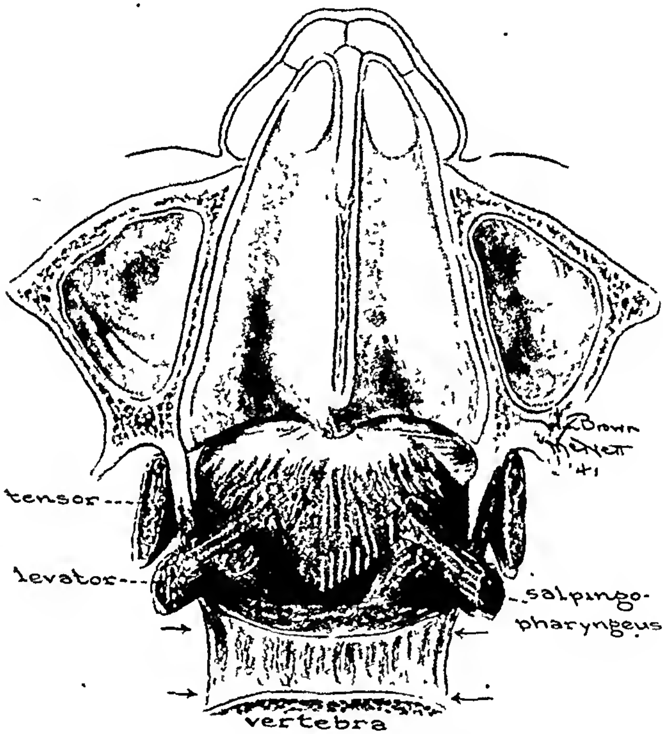


FIG. 33. DEMONSTRATING THE POSITION OF THE SUPERIOR CONSTRICTOR WHEN CONTRACTED TO PRODUCE THE SHUT OFF

We are mindful of the additional stage-operation required, when the vomer flap technic is employed, but it so greatly simplifies the final or "push back" operation that we feel it is indispensable. When the gauze is removed in ten days or two weeks, and the cavity has begun to fill in, it is smooth and rapidly blends with the contiguous surface of the palate (figs. 17, 18, and 19).

TYPE VI. COMPLETE BILATERAL CLEFT WITH RUDIMENTARY VOMER

The vomer is not available for use.

We have not been able to use Veau's method of pulling the nasal mucous membrane over for constructing a nasal lining in a large percentage of cases. In the

high narrow arch, we have found it to be an impossibility. It may be accomplished in a low, wide vault, where the field of operation is much larger and the tissues are more accessible. Furthermore, when this procedure is employed, it is of value only when the Langenbeck, or similar operation, is performed for final

FIG 34. LATERAL VIEW OF THE POSITION OF THE PALATE MUSCLES IN A CLEFT INVOLVING THE BONY PALATE BEFORE OPERATION

correction. If further retrodisplacement is anticipated, the nasal mucous membrane will have to be supplemented. The skin graft, therefore, is the method of choice in these cases.

This is not intended as a criticism of Veau. On the contrary, we agree with him, as mentioned previously, that the necessity of a nasal lining is axiomatic, but

we feel that the use of the skin graft accomplishes this and permits the retrodisplacement necessary for a successful "push back" operation.

Secondary repairs

We have, in former papers, dwelt at length on the shortcomings of the mucoperiosteal and osteoplastic methods of cleft palate surgery. We feel, therefore,

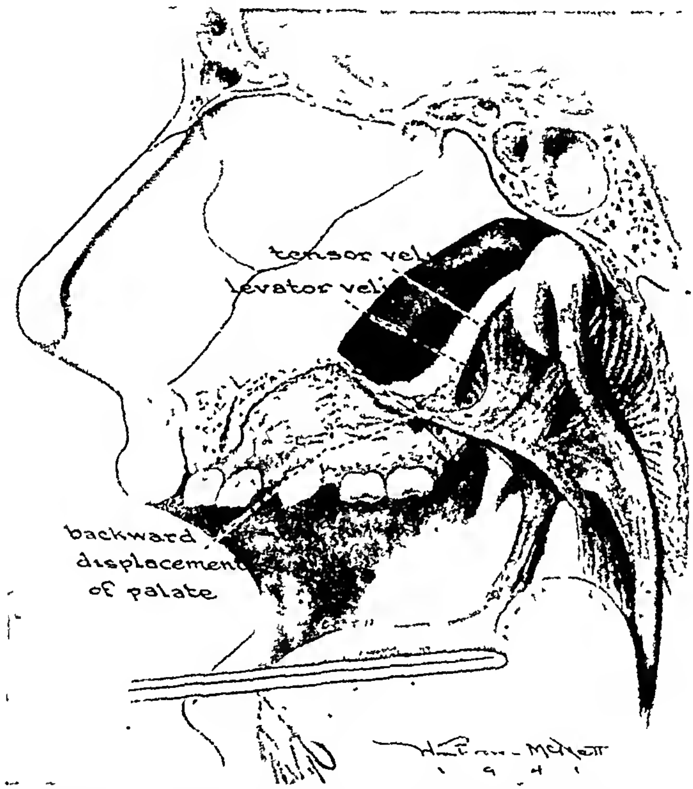


FIG. 35. LATERAL VIEW OF THE POSITION OF THE PALATE MUSCLES IN A CLEFT INVOLVING THE BODY PALATE, AFTER THE "PUSH-BACK" OPERATION

that mention of our methods of full correction of these previously operated cases is necessary. We classify these palates as operative successes but speech failures We are mindful of the fact that the other surgeon's successes are not seen by us. We seldom see a palate which had been repaired by the Davies-Colley or Lane methods, where the tissues are in a state of sufficient vitality to risk further surgical correction. In the cases where we tried a "push back" operation for correction of speech, little or no improvement resulted. We have twice successfully performed the "push back" operation after a Brophy osteoplastic repair. We

confess that we have seen speech failures after a "push back" operation. In such cases, the soft palate was not sufficiently separated from the hard palate structures to permit full retroposition. Many of our own Langenbeck repairs, performed years ago, have been functional failures.

The procedures for correcting these speech failures vary with the previous types and number of operations. Generally speaking, a modified "push back" forms the basis of correction on all patients who still have a palatal insufficiency and speak with the characteristic nasal tone. These secondary corrections have been very gratifying and all cases have been improved.

It is important to carefully plan the operation in each case so as to obtain maximum correction with minimum surgery. The plan is based on factors, the presence or absence of which influence the efficiency of the operation—the most important is the amount of bony palate present and the degree of vomer development.

Using a sharp needle, the edge of the bone is followed completely around the palate, automatically outlining the flaps.

The first stage consists of elevating the mucoperiosteum; dividing the palatine vessels (if not done at the previous operation). Next, insert the skin graft if it is to be employed. It is very difficult to insert skin grafts in cases that have been operated upon many times before. Fortunately, the marked overproduction of fibrous tissue, existing from repeated trauma, is not so prone to contracture, and the skin grafts are not as necessary.

The second stage of the push back operation is performed three to ten weeks later.

The hamular process is divided on each side, and the soft palatal tissues are completely separated from the posterior border of the hard palate. The lateral tissues are bluntly dissected out until the internal pterygoid muscle is reached, at which time there should be sufficient retroposition of the tissues. The flap or flaps are then sutured as previously described.

It is to be emphasized that in these secondary repairs it is necessary that overcorrection be made.

We have inserted figures 32, 33, 34, and 35 to show our conception of why the "push back" operation by retrodisplacement of the palate offers the proper setting for the constrictor muscles to accomplish velopharyngeal closure.

We have never contended that the "push back" operation is necessary in every case of cleft palate but we insist that where a short palate exists, this operation does offer a better chance of articulate speech by bringing about velopharyngeal closure.

MULTIPLE EXCISION AND Z PLASTICS IN SURFACE RECONSTRUCTION

FERRIS SMITH, M.D.

Grand Rapids, Michigan

It is the author's good fortune to discuss this subject again with distinguished colleagues who devote their thought and various abilities to the attainment of the ideal in the special surgical field which deals with reconstructive restoration of normal function and cosmesis.

It is well to emphasize again that this responsibility for both function and cosmesis requires a type of thinking and planning quite different from that required to properly and successfully employ the commonly practiced types of reconstruction.

Davis reviewed the literature of one part of this consideration in 1931. He pointed out to the profession in an excellent article the rationale, some of the useful applications and the technique of the Z plastic procedure. He stated that "the utilization of such tissue (scar flaps) for the relaxation of scar contraction is not generally understood although the Z type of incision by which it is accomplished is an old procedure" (1).

Davis and Kitlowski presented another excellent discussion of the use of Z plastic for the relief of scar contraction in 1939 (2). They discussed a long, satisfactory personal experience and reviewed Limberg's papers which clearly discuss the theory and practice of the procedure (3). They state that "the Z incision is now well known and the method is frequently used by surgeons who are accustomed to dealing with scar contractures. . . . . We find that there are many who do not understand the principle of the procedure at all, or realize its usefulness."

Davis, in a paper in 1929 dealing with the gradual partial excision of scars and large disfigurements, reviews the literature and discusses the second phase of this consideration. He states "I have used gradual partial excision with closure successfully in removing extensive scars, large pigmented moles, pigmented naevi, haemangiomata, tattoo-marks, x-ray and radium burns, localized scleroderma, keloid, etc. and have found that by this procedure that these cutaneous disfigurements may be eliminated without mutilation, and that better results may be obtained than by any other method with which I am familiar" (4).

The author has emphasized on previous occasions over a period of time that the employment of the principle of Multiple Excision, a better understanding of the varied uses of Z plastics and the use of flaps of normal tissue from the vicinity of the deformity will improve greatly the end results (5) (6).

Some of my purposes and methods of employing Z plastic flaps and the technique of multiple excision differ markedly from those described originally and commonly practised.

The Z type of incision and flap formation, described for the relaxation of scar contracture, is an old procedure which has enjoyed little of the thoughtful con-

sideration and actual application to which it is entitled. It was employed first by Denonvilliers in 1856 for the correction of an ectropion of the lower eyelid (7). It was employed by his contemporaries, such as Szymanowski, apparently lost sight of for years, and rediscovered frequently since Piechaud described the procedure for the relief of axillary and other contractures in 1896 (8). Berry and Legg described its use for correction of misplaced tissue along scar in the lip (9); Morestin used multiple Z flaps for correction of flexor scar contraction of the fingers (10); Pieri for deepening the commissures of the fingers in burned hands (11); Davis for scar contractures of the face and neck (12); Babcock for finger webs (13) and Steindler for webs in the hands (14).

The procedure as originally and subsequently described depends upon the shifting of scar infiltrated soft parts bordering the contracture to lengthen the line in which tension or "pull" occurs. This is in contrast to the excision of this scar and the introduction of new tissue, as generally practised.

It is the author's purpose to call attention again to the value of this procedure and to illustrate a few of its many applications in the correction of disabilities resulting from scar and contracture. He wished to emphasize that it is a procedure of choice in the correction of such disabilities anywhere on the body surface and that it should have first consideration, along with two other procedures in the correction of surface functional and cosmetic disabilities of the face, trunk and extremities.

He wishes, further, to describe again a different use for the Z procedure which, combined with multiple excision, permits the complete substitution of normal for pigmented or other pathologic tissue without consequent distortion of eyelids, nose, angles of the mouth or ears. In other words, an end result which approaches the normal and cannot be accomplished in any other way.

This incision makes possible the transfer of pathological tissue from an area where multiple excision would create a pull or traction producing distortion of normal features, such as eyelids, alae of the nose, angle of the mouth, etc. or undesirable scar about a joint. It is exchanged for good skin which may be advanced along lines that produce no distortion.

This is particularly valuable in the infraorbital area and on the upper lip where it is essential to leave the philtrum and angles of the mouth unchanged. The method is not useful in the upper infraorbital area in the male because of the introduction of hair bearing skin. Abnormal skin of this area is better eliminated by the introduction of an interpolated temporal flap or a graft.

The principle of multiple, partial excisions was first discussed by Morestin as a gradual reduction of surface deformities (15).

Its rationale is based upon the fact that the skin in early and middle life is elastic and that it rapidly regains a normal relaxation and elasticity after being put on marked stretch or tension.

It is logical, sensible and easy of execution whenever there is sufficient normal skin bordering the defect to permit its removal and repair. The procedure may be utilized for burn scars and keloids, large traumatic scars, congenital pathology of various sorts, etc. but not for malignant tissue. A desirable cosmetic result is rarely obtained with transplanted skin flaps and grafts.

MULTIPLE EXCISION AND Z PLASTICS IN SURFACE RECONSTRUCTION

FERRIS SMITH, M.D.

Grand Rapids, Michigan

It is the author's good fortune to discuss this subject again with distinguished colleagues who devote their thought and various abilities to the attainment of the ideal in the special surgical field which deals with reconstructive restoration of normal function and cosmesis.

It is well to emphasize again that this responsibility for both function and cosmesis requires a type of thinking and planning quite different from that required to properly and successfully employ the commonly practiced types of reconstruction.

Davis reviewed the literature of one part of this consideration in 1931. He pointed out to the profession in an excellent article the rationale, some of the useful applications and the technique of the Z plastic procedure. He stated that "the utilization of such tissue (scar flaps) for the relaxation of scar contraction is not generally understood although the Z type of incision by which it is accomplished is an old procedure" (1).

Davis and Kitlowski presented another excellent discussion of the use of Z plastic for the relief of scar contraction in 1939 (2). They discussed a long, satisfactory personal experience and reviewed Limberg's papers which clearly discuss the theory and practice of the procedure (3). They state that "the Z incision is now well known and the method is frequently used by surgeons who are accustomed to dealing with scar contractures. . . . . We find that there are many who do not understand the principle of the procedure at all, or realize its usefulness."

Davis, in a paper in 1929 dealing with the gradual partial excision of scars and large disfigurements, reviews the literature and discusses the second phase of this consideration. He states "I have used gradual partial excision with closure successfully in removing extensive scars, large pigmented moles, pigmented naevi, haemangiomata, tattoo-marks, x-ray and radium burns, localized scleroderma, keloid, etc. and have found that by this procedure that these cutaneous disfigurements may be eliminated without mutilation, and that better results may be obtained than by any other method with which I am familiar" (4).

The author has emphasized on previous occasions over a period of time that the employment of the principle of Multiple Excision, a better understanding of the varied uses of Z plastics and the use of flaps of normal tissue from the vicinity of the deformity will improve greatly the end results (5) (6).

Some of my purposes and methods of employing Z plastic flaps and the technique of multiple excision differ markedly from those described originally and commonly practised.

The Z type of incision and flap formation, described for the relaxation of scar contracture, is an old procedure which has enjoyed little of the thoughtful con-

pigmented flap by multiple excision The patient disappeared from service when the procedure was nearly completed A very simple multiple excision would provide a normal frontal scalp area

Case 1 (a) Third degree burn scar (b) Partial repair of face by multiple excision. (c) Exchange of hair bearing scalp and temporo-parietal scar by Z plastic Transfer of a supraclavicular pencil tube for repair of the helix (d) Temporoparietal scalp scar removed by multiple excision Reconstruction of the helix.

Case 4. Burn scar contraction of the flexor surface of the first three fingers, thumb and the adjacent palm The scar infiltrated skin was utilized in the flaps formed by Z incisions for the repair.

The PLANNING in large defects must be carefully and correctly considered. It must contemplate distortions of the eyelids, alae, tip of the nose, and the angles of the mouth. These are of no interest, if they are temporary and will be eliminated with the completion of the work. The ultimate scar should be located in a least conspicuous place and should be linear and fine.

Morestin and Davis utilize various incisions in the lesion or deformity and depend upon the elasticity of the bordering skin for closure. This permits of frequent excisions but accomplishes less at each procedure than the method which is to be described. Morestin has operated some cases as frequently as each three or four days. Davis excises the maximum that will permit closure without undercutting the bordering skin and waits long periods of time between operations. He says "the amount which it is safe to excise varies with the elasticity of the skin around the disfigurement and the determination of this point is sometimes a nice one, as it is essential in carrying out the procedure that the wound be immediately sutured and that peripriman healing follow"—"Ordinarily, I prefer not to undercut as undercutting tends to make more scar, and the tissues do not loosen as readily for the secondary operations."

Our technique varies in several respects, except in small lesions. The type, size and distribution of the lesion determines the location of an incision which, after undercutting, permits the maximum advancement of normal surrounding skin without distortion of the lids, nose, mouth, etc. This may ultimately effect complete new skin covering of the face, etc.

The maximum possible removal of the lesion and the certainty of exact closure by fine sutures along any line is accomplished by undercutting the lesion and passing mattress sutures through the lesion which draw the edge of the cut skin under it to the line to be incised in the lesion. The use of this suture and of Z plastic to transfer portions of the lesion to areas where its removal will not cause deformity are described in the discussion of the succeeding cases.

The following cases will serve to illustrate this type of planning and procedure in various localities of the body surface.

Case 1. A second and third degree burn destroying the hair bearing scalp of the temporo-parietal region, skin of the upper half of the right face and neck, the helix of the ear and the eyebrow. Hair bearing scalp was exchanged for the temporal scar by Z plastic, the exchanged scar tissue eliminated by multiple excision, the hypertrophied facial scar replaced by normal skin from the lower face and neck by multiple excision, the helix repaired with a small tubed pedicle taken from the clavicular region and the eyebrow replaced by a full thickness scalp graft.

Case 2. A verruca type tumor (Seborrheic Keratosis) removed by multiple excision. A relaxation incision in the parietal area permitted advancement of hair bearing scalp to close the defect resulting from removal of the vertical portion of the tumor. The wide relaxation area was covered with a very thin split skingraft and allowed to contract. This skin area was subsequently removed by multiple excision.

Case 3. Pigmented, hairy mole of the entire left forehead scalp. Partial removal by multiple excision. Further removal by Z plastics which permitted exchange of normal flaps of scalp tissue for similar flaps of pigmented tissue and the ultimate removal of this

a b

c d

Case 3. (a) Pigmented hairy mole. (b) Result of multiple excision. (c) Z plastic for introduction of normal scalp. (d) Small remnant of mole to be removed by excision.

Case 7. Congenital web between the proximal phalanges of the first and second fingers and the entire second and third fingers. Reconstructed by Z plastic procedure.

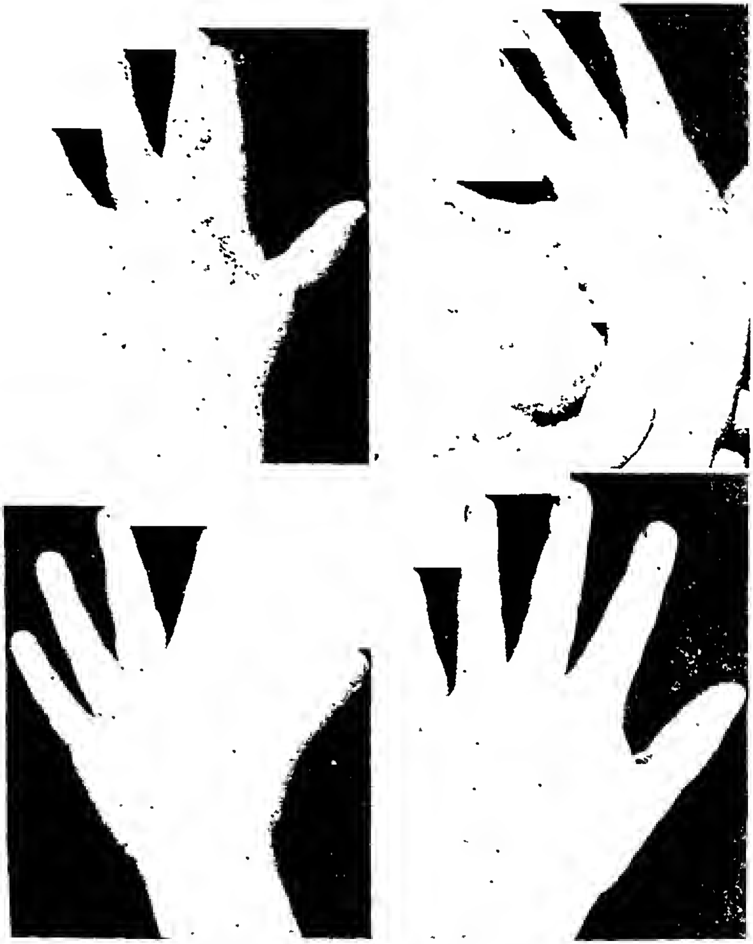
Cases 5 and 6. Third degree burn scar. Destruction of the web between the first and second and second and third fingers. Adhesion between the proximal portions of the first

Case 2. (a) Seborrheic keratosis. (b) Partial multiple excision (c) Completely excised tumor. Advanced hair bearing scalp. Relaxation incision and thin split graft. (d) Completed multiple excision.

and second fingers. Hypertrophied scar of the skin of half the dorsal surface of the hand. The hand in Case 5 is reconstructed by Z plastic and multiple excision. Reconstruction in Case 6 is by multiple excision.

Cases 8 and 9. These cases illustrate congenital constriction bands around the lower leg. These bands have been released and the skin of the area relaxed by Z plastic. Case 8 was released by a complete Z procedure around the entire circumference of the constriction.

a b



c d

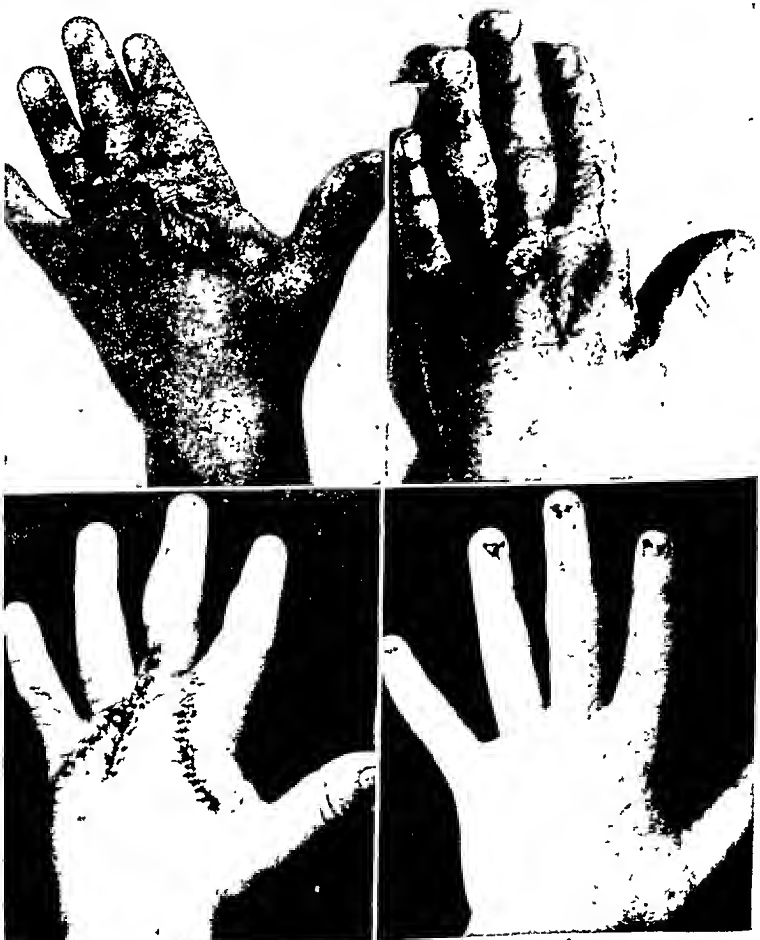
Case 6. (a) Third degree burn scar. (b & c) Stages of multiple excision. (d) Completed.

This procedure is a surgical mistake because of the section of the superficial lymphatics. Contrast the foot prior to and following operation. The lymphedema in the foot still persists after several years. The constriction band in Case 9 was corrected by two Z plastics, one on the external and one on the internal surface. The lymph circulation of the ankle and foot are normal post-operatively.

a b c

Case 4. (a) Flexor burn scar contraction. (b) Z plastic reconstruction. (c) Completed repair.

a b

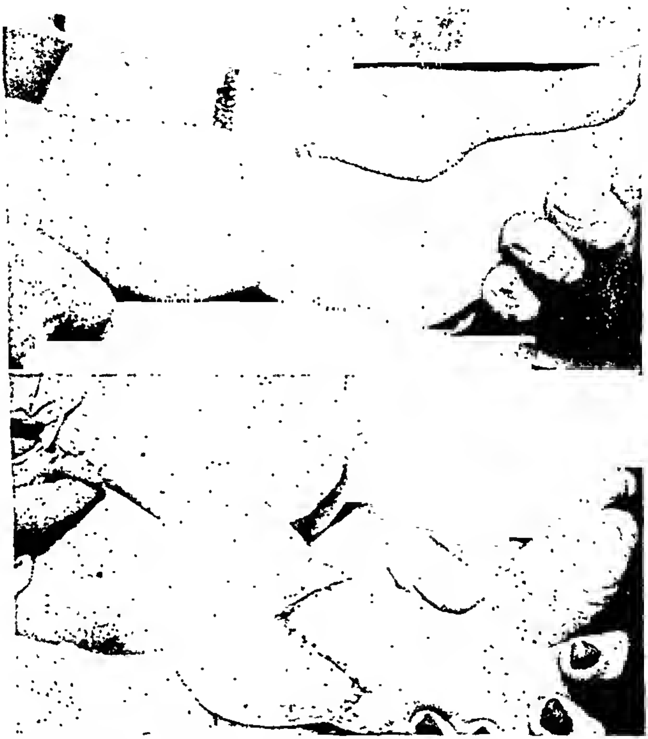


c d

Case 5. (a) Third degree burn scar. (b) Z plastic. (c) Multiple excision second ... (d) Completed repair by multiple excision and Z plastic.

Case 12. Pigmented, hairy mole involving the upper arm and elbow. Pigmented skin is replaced by multiple excision with skin transferred from the axilla and thorax by direct flap.

Case 13. This case has been presented in an unfinished state previously. It illustrates clearly both points of the procedures under discussion. The skin of the upper two-thirds



Case 9. (a) Congenital constriction band. (b) Partial Z plastic relaxing the band. Note normal ankle and foot.

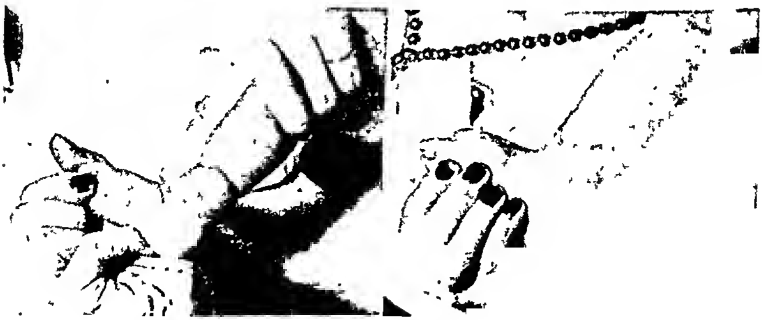
of the cheek and upper portion of the neck beneath the hair present a pigmented naevus with areas of skin atrophy following treatment by radiation and carbon dioxide snow during childhood. It also presents a sarcoma in the infraorbital region as the result of radiation, etc. The asymmetry of the face results from the arrested development caused by early radiation treatment.

The cheek is covered with normal skin from the lower face and neck as the result of multiple excision. This process was continued until the line of normal skin ran from the angle of the mouth to a point slightly beyond the external canthus. Note at this point (fig. b, Case 13) the exchange of a flap of normal skin from the cheek for a similar flap of pigmented tissue from the infraorbital region. This flap of normal skin was advanced to the nasal border and the pigmented tissue below it removed by multiple excision (fig. c,

Case 10. This case illustrates the correction of a pigmented naevus in the infraorbital region by Z plastic and multiple excision. Note the exchange of the superior entirely involved triangular flap for the inferior one which presents a small circular area of pigmentation. This flap is advanced successively by multiple excision until the spot of pigmenta-

a b

Case 7. (a) Congenital web. (b) Completed Z plastic repair.



a b

Case 8. (a) Congenital constriction band. (b) Complete Z plastic repair. Note chronic lymphedema of foot and ankle

tion is eliminated. The final scar in the naso-facial groove is stretched as the result of tension and time and the right ala requires elevation. This is readily accomplished by excision within the indicated design

Case 11. Cavernous haemangioma of 25 years duration. Ulceration of the mucosa. Recent frequent spontaneous hemorrhages. Ligation and dissection of the involved vessels, etc. Multiple excision was performed in two stages to complete the reconstruction.

Case 13) The final scars surround the ear attachment and present in the infraorbital area as appear in (figs c and d, Case 13).

Case 11 (a & c) Cavernous haemangioma and ulcer (b & d) Correction by multiple excision.

Case 14 Third degree burn scar with marked hypertrophy, destruction of the skin and marked elevation of the ala of the nose The Z plastic procedure previously described was utilized to introduce new normal skin into the neck and cheek and transposed a large triangle of hypertrophied skin from the cheek to the neck where it could be removed by

a b c d

Case 10. (a) Infraorbital pigmented naevus. Z plastic and multiple excision. (b & c) Continuation of multiple excision. (d) Stretched scar and low ala to be corrected by excision according to the design.

multiple excision The multiple excision subsequent to the original Z plastic procedure advanced the point of the normal triangle of skin to the angle of the mouth and resulted

a b c d

Case 13 (a) Treated pigmented naevus with areas of skin atrophy Infraorbital sarcoma following radiation Arrested development Facial asymmetry (b) Result of multiple excision New skin line passes from the external canthus to the angle of the mouth Z plastic to exchange infraorbital pigmentation for normal skin in preparation for multiple excision without ectropion (c) Later stage of multiple excision (d) Result of multiple excision and Z plastic Courtesy of J A M A

in the elimination of the involved skin of this area The involved skin of the cheek superior to the margin of the triangular normal skin flap was removed by multiple excision Note the second stage of this procedure in fig c, Case 14) Also note the elimination of the scarred skin of the lip by a similar procedure

a b c

Case 12 (a) Pigmented hairy mole (b) Direct axillary and thoracic flap (c) Result of multiple excision

The burn scar of the entire nose was removed, the scar elevating the ala excised and its margin returned to normal position. The entire nose was covered with full thickness skin from the mesial surface of both ears.

The possibility of the use of one of these methods, or a combination of them, determines a "choice of procedure" in planning and effecting the reconstruction. This choice is made against the universally popularized and accepted use of tubed pedicled flaps, free grafts and rotated forehead flaps in surface repair. The latter properly constitute "procedures of necessity" in many cases and should be recognized as such as compared to those of "choice."

Some 5000 years elapsed from the time of the first record of rotated flaps before their value in surface repair was generally recognized, standardized and their universal employment popularized. The art of free grafting was lost for six centuries. The universal use of grafts on a large scale has been standardized and popularized in the last quarter of a century. Interpolated flaps from the border of a defect were successfully utilized for many years prior to World War I.

The universal popularization of pedicled flaps and free grafts has almost eliminated them from the planning of repair during the subsequent years.

The Z plastic procedure is only an infant in this group of procedures. It is only 90 years old. Its use in the relief of scar contraction in various locations and manners is a mere 20 years old. Its value in the sequence of well planned procedure is not yet fully appreciated and practised. It is one of the most valuable single procedures available to the surgeon.

The author's purpose is maniforld. He is concerned with the dual quality of the end results which have characterized the modern plastic repair of the last 25 years and with the hope that these considerations will alter much of our planning and add materially to our art and finesse.

REFERENCES

1. Davis, J. S.: The relaxation of scar contractures by means of the Z or reversed Z type incision. Ann. Surg., 871–884 (Nov.) 1931.
2. Davis, J. S., and Kitlowski, E. A.: The theory and practical use of the Z incision for for the relief of scar contractures. Ann. Surg., 109: 1001–1015 (June) 1939.
3. Limberg, A. A: Collection of scientific works in memory of the 50th anniversary of the Med. P. G. Inst. Leningrad, 461–489, 1885–1935.
   Idem: Skin plastic with shifting triangular flaps. Leningrad Traumatological Inst., 862–872, 1929.
4. Davis, J. S.: The removal of wide scars and large disfigurements of the skin by gradual partial excision with closure. Ann. Surg., 645–653 (Oct.) 1929.
5. Smith, Ferris: Some refinements in reconstructive surgery of the face. J. A. M. A. 120: 352–358 (Oct. 3) 1942.
6. Smith, Ferris: Planning the reconstruction. Surgery, 15: no. 1, 1–15 (Jan.) 1944.
7. Denonvilliers: Blépharoplastie. Bull. Soc. de Chir. de Paris, 7: 243, 1856–7.
8. Piechaud, T: Deux observations due symphyse des membres à la suite de brulures étendues. Rev. d'orthop., 7: 81 (March) 1896.
9. Berry, J., and Legg, T. P.: Harelip and Cleft Palate. P. Blakiston Son & Co., p. 148, Philadelphia, 1912.
10. Morestin H: De la correction des flexions permanentes des doigts, etc. Revue de Chir., 50: 1 (July) 1924.
11. Pieri, G.: Ricos truzione del pollice del moncone della folange basale. La. Chir. degliorgani dimovimento, 111: 325, 1919.
12. Davis, J. S.: Plastic Surgery. P. Blakiston's Son & Co., pp. 275, 372, 546, 547, 553, 632, 633, Philadelphia, 1919.
    Davis, J. S.: Arm-Chest Adhesions. Arch. Surg., 1–23 (Jan.) 1924.

a b c d

Case 14 (a) Third degree burn scar with hypertrophy Destruction of nasal covering Scar elevation of the ala (b) Scar removed and alar position restored Complete nasal covering with skin from both ears First stage of Z plastic to correct condition of face (c) Second stage of multiple excision (d) Result of Z plastic, multiple excision of facial and lip scar, full thickness graft covering of entire nose, etc Courtesy of J A M A

REPORT OF A CASE OF PROGRESSIVE FACIAL HEMIATROPHY WITH PATHOLOGICAL CHANGES AND SURGICAL TREATMENT

WM. S. KISKADDEN, M.D. AND MAR W. McGREGOR, M.D.

The purpose of this paper is to report a case of progressive facial hemiatrophy, and to describe the pathological changes found in the biopsied specimen, changes to our knowledge not previously described in the literature. We wish also to describe a method of treatment used in the correction of the deformity resulting from the condition.

There are two important types of this disease, the congenital, nonprogressive form characterized by congenital hypoplasia with subsequent retardation of growth of the affected side, and the progressive form of facial hemiatrophy. This begins early in life, generally before puberty. It affects either side of the face with no differentiation in sexes. The symptoms are those of a progressive atrophic process involving the skin, subcutaneous fat, connective tissue, muscles and bone. Often the first manifestation is a white area of atrophic skin, frequently near the orbit or over the upper jaw. There follows a slow but progressive atrophy of the fat and muscle with the resulting shrunken appearance of the affected side of the face. The skin often appears to lie tightly on the bones of the face. There is generally no anesthesia. Facial muscles are intact and active. The atrophy may involve the scalp, with loss of hair.

The cause of this disease remains obscure. Walsh (3) reviewed the theories of etiology and the following has been taken from his article in an attempt to recall briefly the current theories.

The trigeminal peripheral-neuritis theory. Mendel in 1889 examined a single case at autopsy and found a peripheral interstitial neuritis of the fifth nerve. He cautiously suggested that this might be the basic factor in initiating the disease process.

Pain in the region of the fifth-nerve distribution is a frequent symptom and may be a precursor of hemiatrophy (Oppenheim). However, typical trigeminal neuralgia is not followed by hemiatrophy. The trigeminal neuritis theory seems to be invalid because (1) section of the sensory root of the trigeminus does not result in facial hemiatrophy; (2) the atrophic process does not start invariably in, or remain in, the region of trigeminal innervation.

The sympathetic theory. Involvement of the cervical sympathetic probably through vasomotor control has been considered frequently as the cause of the condition (Sachs, Cassierer, Siebert). Trauma has been recorded as an initiating factor. (Bost)

On the basis of the "trophic" nature of the lesions, many authors thought there was involvement essentially affecting the sympathetic system, either through the cervical sympathetics or central sympathetic tracts, including the parasympathetics. Stief reported the autopsy findings in a case of right-sided, progressive hemiatrophy with sclero-derma in a woman of 64 years (the oldest hemiatrophy case observed) over a period of four years. There was generalized sclerosis of the central vessels, and the brain itself showed various stages of necrosis with an interesting difference in the two hemispheres. The left hemisphere in its entirely showed coagulative necrosis, apparently from anemia; whereas the right hemisphere showed vascular dilatation and stasis. This difference between the right and left halves was less marked in the brain stem than in the right hemisphere. Stieff also found round-cell infiltration in the right cervical ganglia. He thought that the vasomotor

Davis, J. S.: Contracted Scars—Section on Plastic Surgery, Practice of Surgery. Dean Lewis, Vol. V, p. 108, ch. 8, 1930.
13 Babcock, W. W: A textbook of Surgery. W. B. Saunders Co., p. 1294, Philadelphia, 1928.
14. Steindler, A: Reconstructive Surgery of the Upper Extremity. D. Appleton Co., p. 119, New York, 1923.
15. Morestin, H: La réduction graduelle des difformités tègumentaires. Bull. et mém. de la Soc. de Chir. de Paris, Vol. XLI, p. 1233, June 16, 1915.
Morestin, H: Cicatrice très étendue du crâne réduitepar des excisions successives. Bull. et mém. de la soc. de chir. de Paris, 42: 2052 (Sept. 13) 1913.

Family history. Negative. No history of similar illness in any member of the family.

Past history. Essentially negative except for scarlet fever, measles, chicken pox, pertussis in childhood. Fracture of right clavicle at age of three years.

Present illness. When the patient was fifteen he recalls a small white spot appearing in the skin just below the right eye. At about this same age the skin of the right side of the neck became somewhat tan in color, remained slightly pigmented.

FIG. 3. X-RAY SHOWING TANTALUM PLATE IN POSITION OVER RIGHT MALAR BONE

At surgery a biopsy of skin was taken from the chin. The specimen crossed the line of atrophy thus one-half of the specimen was what appeared to be normal skin. A piece of muscle was taken from the right side of the face.

No medical treatment was requested at this time. The pigmentation in the neck and the face remained unchanged. Following an attack of "impetigo of the face" at the age of sixteen, the patient noticed an indentation in the right side of the chin During the next two years there was a marked and progressive change in the contour of the right side of his face. At this point the diagnosis of progressive facial hemiatrophy was made.

Considerable treatment was given during the ensuing eight years. This treatment consisted of electrical stimulation of facial muscles, heat and massage. It included osteopathic and chiropractic adjustments; no benefit was demonstrable. During the past six years there had been no progress of the disease He was referred to our office on August 10, 1945 for the treatment of the deformity resulting from the many years of progressive atrophy of

change in both hemispheres, upon involvement of the cervical sympathetics—that on the right to vasomotor paralysis and that on the left to vasomotor irritation. He thought that the hemiatrophy in his case was due to destruction to the opposite thalamus.

As further case records accumulated, symptoms other than facial atrophy were noted, and it became apparent that involvement neither of the trigeminus nor of the sympathetic could adequately explain the entire picture.

The infection theory. Many cases have been described as occurring after infectious diseases, and Mobius (Oppenheim) thought that progressive hemiatrophy was due to some

Fig 1 Fig. 2

Fig 1 Before Note the Indentation on the Chin and Along the Right Side of the Face

Fig 2 After Picture Taken Eight Months after Surgery

There is still some indentation of the skin along the right side of the face, however, the lines are considerably smoother and the appearance has been improved.

infectious process Infection from the tonsils or following adenoidectomy has been mentioned

Heredity of facial hemiatrophy. Klingmann in this country described a family in which the grandmother, mother, and her twin daughters showed the defect, degeneration, and remarked that, in common with other such diseases, it often makes its appearance at the time of puberty. He further stated that, as in the other degenerative diseases, it may be accompanied by imbecility, congenital paralysis of the eye muscles, facial paralysis, and other conditions. However, heredity is not stressed by most authors.

The report of our case follows:

History. Mr. J. C., age 26, white, male, musician, entered our office because of marked self consciousness which had developed to the point that following his discharge from the army he had not sought employment and had become a recluse.

the right side of the face. His main concern was the correction of the appearance of the right side of his face.

Physical examination. White, male, age 26, 5′ 7½″, weight 132 pounds, ambulatory. There is a deformity of the right side of the face. The skin has dropped into deep hollows below the right eye and right malar bone. There is a definite lack of fullness along the right mandible as compared with the left. There is a small scar over the right side of the chin. The right side of the neck is pigmented slightly more than the left. The forehead and scalp are not involved. There are no eyelashes in the right lower lid and right eyebrow is thinner than the left. The remainder of the physical examination is noncontributory.

Detailed neurological examination, response to electrical stimulation of muscles, x-ray and laboratory reports are all within normal limits.

FIG. 4. INFLAMMATORY PROCESS SURROUNDING AND INVADING A NERVE

Course. Sept. 10, 1945, patient was taken to surgery. A curved incision was made along the right infraorbital ridge. The skin and subcutaneous tissue was elevated and a 0.015 tantalum plate was cut and bent to fit over the malar bones. Attachment by wiring was made to the zygoma with its junction to the infraorbital rim of the malar. The rational was that this plate would elevate the skin away from the bone thus filling out the cheek and restoring in part the normal symmetry of the face. The wound healed by first intention and without drainage. There have been no complications from the presence of the metal plate beneath the skin. It has remained secure and fixed. The patient previously had been extremely self conscious of his appearance. Since surgery he has expressed considerable satisfaction at the improvement and is now at work.

The pathology report as rendered by Dr. Roy Hammock, Good Samaritan Hospital, Los Angeles, is as follows:

Tissue from the left side of face. "There are three irregular pieces of tissue. One consists of an eliptical piece of skin measuring 2.5 cm. in length, 8 mm. in width and up to 5

MARKED SENSITIVITY TO SCARLET RED OINTMENT

Loss of Skin Grafts and Destruction of Donor Areas

WILLIAM G. McEVITT, M.D.[1]

Detroit, Michigan

The dye, scarlet red, was discovered in 1882. The term is used loosely in referring to two different compounds: Scarlet red medicinal (Biebrich) (Amido-azotoluol beta naphthol) and scarlet red sulfonate (sodium salt of azobenzene-disulfonic acid azobetanaphthol). Early in this century Fisher (1) injected the dye into the ears of rabbits and noted that it caused epithelial proliferation in the basal layers of the skin. This led Hager (2) and others to give it a clinical trial in Europe. These workers felt that growth of human covering epithelium was stimulated by the dye.

In the United States J. S. Davis (3) was the first to test scarlet red scientifically. In a series of reports from 1909 to 1913 he published his impressions which confirmed the work of the German writers. Despite encouraging reports, the substance did not achieve wide popularity until Bettman (4), in 1931, introduced his ointment which combined scarlet red medicinal (Biebrich) with oxyquinoline sulfate as an antiseptic and chlorbutanol as a mild antiseptic and local analgesic. Bettman's formula usually used as gauze impregnated with the ointment has had a very general usage. It is the impression of the writer from his clinical experience that there is little doubt that the ointment greatly accelerates the growth of epithelium, thereby promoting early healing of ulcers and granulating areas. Hertz (5) using 8% original Biebrich healed a granulating area 10 x 13 inches in eleven days. Dr. Straith applies the Bettman gauze as a dressing following paring down of a rhinophyma. Healing with a very normal appearing skin surface is usually complete in seven to ten days.

So far as the writer knows the case herein reported is the first in the literature where a skin graft has come to grief because of scarlet red dye. Sensitivity to dyes is, of course, not uncommon and is well known to dermatologists. Apparently few patients are allergic to scarlet red, although as this case illustrates, the diagnosis can easily be missed. Dr. Davis (6) in his lifetime of experience, has not had such a case. Several have come to the attention of Dr. Bettman (7), but as he states not enough to constitute a problem.

CASE REPORT

E. B., white, female, age 28 was admitted to Harper Hospital 7–4–45 with complaint of unhealed leg ulcers. Four months previously she had fallen on concrete steps, severely lacerating the anterior surfaces of both legs about 10 cm. above the ankles. The wounds were sutured immediately but the skin became necrotic and sloughed leaving a large ulcer on each leg. These had been treated with various local applications without success. On admission she had a granulating area on each leg about 7 x 5 cm. in extent.

[1] Associate, the Straith Clinic, Oral and Plastic Surgery.

mm. in thickness. On the skin surface there is a longitudinal median cleft. Another piece consists of fat, and the third piece is probably muscular tissue. A section is taken from each of the pieces.

Microscopic: "The sections show a small piece of skin, subcutaneous fat and a small amount of muscle. The skin shows little change. The epithelium is normal. In the corium there is some round cell infiltration, especially in the vicinity of the blood vessels, but this is not marked. There is no appreciable difference in the appearance of the skin at one and the other, though the specimen is said to have been taken across the midline, part of it covering the area of atrophy. Intimately connected with the lower part of the corium there is muscle and in the muscle a few nerve fibers. The muscle stains irregularly, that is, some of it takes the eosin much less intensely than the other and in these pale areas the cross striation is indistinct. The nerve fibers here do show a few round cells within them but there is nothing like the change seen in the separate piece of muscle. In this the same abnormality in staining is seen, but also there are many foci of cellular infiltration. These foci occur between bundles of muscle fibers and in most instances the cells surround and frequently invade small nerves. The cells are principally small round cells resembling lymphocytes, a few plasma cells and occasional larger cells with more deeply-staining nuclei. The nerves appear sometimes to be greatly enlarged by this infiltration. The blood vessels, especially the arterial vessels show little abnormality, although occasionally one sees groups of round cells in or adjacent to the wall of some of the veins."

In summary, there is a chronic inflammatory process involving the small nerves within the muscle and, to a less extent, forming small, inflammatory foci in the muscle, apparently separate from the nerves. There is also evidence of a degenerative process in the muscle. This inflammatory process is present although six years have elapsed since any demonstrable progress in the atrophy of the face has been noted. Hence it is highly suggestive that the atrophy will progress.

REFERENCES

1. Wartenberg, R. W.: Facial hemiatrophy. Arch. Neurol. and Psychiat., **54**: no. 2, 75–96 (Aug.) 1945.
2. Archambult, LaSalle, and Fromm, N. K.: Progressive facial hemiatrophy. Arch. Neurol. and Psychiat., **27**: no. 3, 529–583 (March) 1932.
3. Walsh, Frank B.: Facial hemiatrophy. Jour. Ophthal., **22**: no. 1, 1–10 (Jan.) 1939.
4. Kazanjian, V. H., and Sturgis, Somers H.: Surgical treatment of hemiatrophy of the face. J. Am. Medical Assn., **115**: no. 5, 348 (Aug. 3) 1940.

were cut from a small thin split skin graft which was removed from the left thigh with a Blair knife. Both donor and recipient areas were dressed with Bettman's scarlet red ointment gauze.

On 8-31-45 the dressings were removed. About 25% of the implantation grafts showed some slight growth. The surrounding tissues were red and brawny. The donor area on the thigh presented a surprise. The raw area left by removal of the graft measured 4 x 4.5 cm. This was weeping copiously and unhealed. The surrounding skin over an area of 8 x 6 inches was involved by an intense erythema surmounted by many vesicles (fig. 1) Suddenly all the previous difficulty became clear. This reaction was so exaggerated and typical of sensitivity that the writer finally understood the cause of difficulty. On 9-1-45 the patient developed generalized urticaria over the body.

All dressings were now removed. All involved areas were cleansed with soap and water to remove the offending ointment and wet dressings of normal saline applied. Patch tests of the various ingredients of the Bettman formula were applied and inspected in forty-eight hours. Chlorotone and oxyquinoline sulfate showed no reaction. Scarlet red N.F medicinal (Biebrich) gave strongly positive reaction showing intense erythema and vesiculation. Scarlet red sulfonate gave an identical reaction.

Discontinuance of scarlet red was followed by rapid healing of the donor areas. The remaining raw areas on the legs took on a much more healthy appearance. On 9-8-45, a small split graft was cut from the right thigh by free hand. It was divided into several postage stamp-sized pieces which were tamped down on the legs. Both areas were dressed with xeroform ointment gauze. Redressing was done 9-18-45. The grafts took completely. The donor area was completely healed and showed no reaction. The patient was permitted to walk and was discharged 9-22-45.

COMMENT

It would, of course, be unfair to conclude from this experience that scarlet red ointments should be discarded. Until a superior material appears, scarlet red seems to be the best stimulant available for epithelial growth. Nevertheless, it should be borne in mind by those dealing with skin grafting that some patients are sensitive to the dye. The surgeon, as happened in this case, may waste much time before the real nature of the trouble becomes apparent. Fortunately for this patient, the area involved was small and donor skin plentiful. Such a complication in a burned child with very little available donor area might well prove a tragedy. Forwarned is forearmed and the damage and loss of time can be minimized if the surgeon has the complication in mind and recognizes it immediately.

REFERENCES

1. Fisher, B.: Munchen Med. Wchuschr., 53: 204, 1903.
2. Haga: Zeitschrift für Krebsforsching, 12: 525, 1913.
3. Davis, J. S.: Bull. Johns Hopkins Hospital, 20: 186, 1909; 22: 210, 1911; 23: 332, 1912; 24: 178, 1913.
4. Bettman, A. G.: Simpler technique for promoting epithelialization and protecting grafts (oxyquinoline sulphate scarlet red ointment). J. A. M. A., 97: 1879, 1931.
5. Hertz, L. F.: Rapid epithelialization following use of scarlet red ointment. Case without skin grafting in extensive third degree burns. M. Rec., 149: 43-44 (Jan. 18) 1939.
6. Davis, J. S.: Personal communication to the author, 1945.
7. Bettman, A. G.: Personal communication to the author, 1945.

Continuous wet dressings of boric acid were applied and on 7–7–45 grafts from the abdomen 0.017″ in thickness cut by the dermatome were applied to both legs after paring of the edges and granulating beds. Both the donor area and the grafts were dressed with Bettman's oxyquinoline sulfate scarlet red gauze. Four days postoperatively the patient's temperature was 103°F. The leg dressings were removed. The area about the grafts was markedly inflamed. Both grafts were floating over what appeared to be sero-purulent material. The grafts were removed and wet dressings of aqueous acriflavine applied to the area.

On 7–18–45 the donor area on the abdomen was exposed. It was surrounded by an area of intense erythema which included the entire abdominal skin. The donor area itself was weeping a seropurulent fluid and most of the skin remaining after removal of the graft had

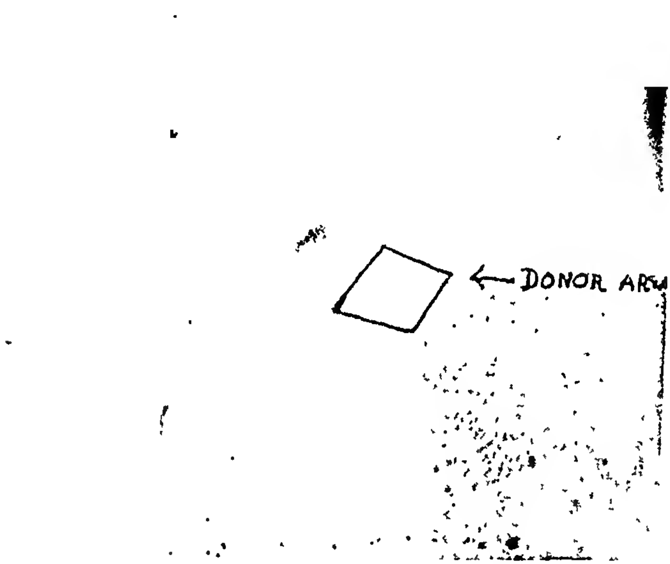


FIG. 1. LEFT THIGH SHOWING DONOR AREA 4 x 4.5 CM. SURROUNDED BY AREA OF INTENSE ERYTHEMA, VESICULATION AND DESQUAMATION MEASURING 8 x 6 INCHES

sloughed exposing fat. This condition was interpreted as infection and continuous wet dressings of boric acid were applied.

On 7–28–45 penicillin therapy was begun intramuscularly. On 8–2–45 the granulating areas on the legs were considered sufficiently clean for regrafting. A skin graft 0.012″ thick, cut by the dermatome, was removed from the right thigh, divided in two pieces and sutured in place on the legs. Pressure dressings using scarlet red gauze were applied to both donor and recipient areas.

The thigh and legs were redressed 8–9–45. The donor area was macerated, weeping and surrounded by erythema. The grafts were largely loose on the recipient beds with a collection of serum beneath their centers. About 40% of each graft had taken, largely on the edges.

On 8–10–45 wet dressings of boric acid solution were applied to the legs. On 8–21–45 the remaining raw areas on the legs were seeded with implantation skin grafts. These grafts

Dieffenbach's plan was, the creation of two secondary defects through the entire thickness of the cheeks has disadvantages. It was improved by Adelmann of Dorpat, and Szymanowski of Kiev, in 1858. The former advised cutting broader skin flaps and in this way closing the secondary defects, at least from the outside; while the latter improved the method by leading the upper incisions not horizontally but obliquely upward, to facilitate closure of the secondary skin defects. But, as far as can be ascertained, no effort has been made as yet to close the muscle and mucous membrane defects in front of the masseter muscle. This triangular defect, in the midst of the cheek covered only by skin, is not only a source of infection but also the cause of a depression of that area. I overcame these disadvantages by transplanting a flap of the masseter muscle into the defect, as I shall describe in more detail.

TECHNIC

The operation is carried out as follows: The incisions are outlined with one of the aniline dyes. Before the anesthetic is administered, I let the patient contract his masseter muscle, and I mark its anterior border at its upper and lower insertions with a drop of methylene blue injected percutaneously. Before operation, I also mark the orifice of Stenson's duct.

Excision of lip and chin. The tumor, together with the soft parts of the entire chin, is excised in a heart-shaped rather than a wedge-shaped piece (Dieffenbach). This results in a more normal looking profile with a dimple in the center of the chin. If it is possible, the excision should not include the entire commissures of the mouth. The reconstruction of a commissure involves another problem. In those cases, I leave a very small flap of the lower lip at either side of the mouth, as outlined in figure 1a. The incisions on either side meet each other at a point below the center of the mandible. This point becomes the point of rotation around which two square flaps are turned from the immediate neighborhood (fig. 1a).

Outlines of the flaps and formation of the new lip. For the formation of the right flap—likewise the left—the following incisions are made (fig. 1a): From the left commissure an incision is carried obliquely upward to about 1½ inches in front of the tragus of the ear. From there the incision is carried downward at an angle less than a right angle, ending below the mandible. The next step is the formation of the left half of the future vermilion border. From the angle of the mouth to the anterior border of the masseter muscle the incision includes skin and muscles, while the mucous membrane is dissected free from the upper wound edge for about 1 cm. In doing this, the external maxillary artery is encountered and ligated. The facial vein, found posterior and more superficial to it, is also ligated and separated. Still more posterior and above is Stenson's Duct; care must be taken not to injure it. The mucous membrane is now separated 1 centimeter above the main flap. This tiny mucous membrane flap is now turned outward to form the right half of the future lower lip. The lateral third of this new lip, due to thickness of the subcutaneous and muscle tissue, is broader than the median parts, which results in protrusion instead

THE MODIFIED DIEFFENBACH OPERATION FOR CLOSURE OF LARGE DEFECTS OF LOWER LIP AND CHIN

HANS MAY, M.D.

Philadelphia

A variety of procedures have been published which recommend the use of full thickness cheek flaps in closure of defects of lip and chin. Some could never have been successfully practiced, and some give poor cosmetic and functional results. Bruns' operation for closure of large defects of lower lip and chin, for instance, is still highly recommended in some of the textbooks. I tried this method, but found the result far from that which the classical illustrations would lead one to expect. There are, however, a few excellent procedures available. Some are well known, a few are less well known. To the latter group belongs the modified Dieffenbach operation. In former publications, I have made efforts to stress its merits.

There still seems to be some hesitation in practicing the operation; one of the reasons probably being the inadequate description which the method has carried in the textbooks. On theoretical rather than on practical grounds, the method is accused in some publications of being mutilating and extensive. I will not deny that the operation is extensive, but correctly performed it is not mutilating.

The operation is applicable whenever the defect of lower lip and chin is triangular and so large that other less extensive procedures, which use full thickness cheek flaps, are not applicable. The advantages of the modified Dieffenbach operation are: excision of the diseased part and closure of the defect in one sitting; and replacement of the lost structures by similar structures, thus restoring original function and appearance.

The operation can be performed unilaterally or bilaterally. It can be combined with other operations such as Estlander's or Burow's, and it also can be combined with a resection of the mandible.

Dissection of metastatic lymph glands, however, should be delayed until all wounds have healed and all edema in the flaps has subsided. The operation is performed under intratracheal anesthesia: the anesthesia tube being inserted through the nose.

This method was originally devised by Dieffenbach in 1834. Its principle is based upon the creation of a triangular defect which is closed by shifting two square flaps around one point of rotation from the immediate neighborhood into the defect. The two square flaps, for closing the triangular defect of lip and chin in Dieffenbach's original operation, reached from the corner of the mouth to the anterior border of the masseter muscles (including a small mucous membrane flap for the formation of the new lip), and from here down to the mandible. The flaps, consisting of the entire thickness of the cheek, were shifted into the defect. The two secondary defects in front of the masseter muscles could be closed only partly, and the rest was left to granulate. Remarkable as

of gradual disappearance of the lateral part of the vermilion border. I avoided it by excising some of the subcutaneous and muscle tissue of the lateral third

A B

C D

FIG. 2A. Patient with large, squamous cell carcinoma of lower lip. No evidence of metastasis. Line of heart-shaped excision outlined. Operation according to the method of figure 1.

FIG. 2B. Same patient five days after the operation. Was discharged twelve days after the operation.

FIG. 2C AND D. Same patient thirteen months after operation. No evidence of recurrence after seven years.

of the new lip, and trimming the mucous membrane accordingly. Martin also recommends this for Bernard's operation.

FIG. 1A Heart-shaped excision of lower lip and chin is outlined Also the two small flaps which are to cover the defect; two small flaps at angle of mouth preserved. The inside incision for mobilization of flaps from the mandible and from the anterior border of the masseter muscles are outlined by dotted lines. Also the small mucous membrane flaps for formation of the vermilion border. (Courtesy of Surgery, Gynecology, and Obstetrics, 73: 236, 1941)

FIG. 1B The left flap is mobilized, the small mucous membrane flap is sutured to the outer edge of the main flap. The right mucous membrane flap for formation of vermilion border is being freed. (Courtesy of Surgery, Gynecology, and Obstetrics, 73: 236, 1941.)

FIG. 1C. Closure of the triangular muscle and mucous membrane defect in front of the masseter muscle by mobilization of the mucous membrane as far as possible, and transplantation of the flap consisting of the lower anterior half of the masseter muscle. The mobilization of the flap is exaggerated in this drawing for demonstration purposes. (Courtesy of Surgery, Gynecology, and Obstetrics, 73: 236, 1941)

FIG. 1D. The original and secondary defects are closed. (Courtesy of Surgery, Gynecology, and Obstetrics, 73: 236, 1941.)

A B

C D

Fig 4a Patient, age 60 years, with squamous cell carcinoma involving almost the entire lower lip, the left angle of the mouth, and the left quarter of the upper lip Due to extent of the lesion, irradiation was contraindicated No evidence of metastasis Lines of excision are outlined

Fig 4b After excision of the diseased tissue

Fig 4c The defect was closed with the modified Dieffenbach method Flaps were formed on either side of the defect Formation and mobilization of the left composite cheek flap The defect of the upper lip was closed by simple skin sliding

Fig 4 d and e Five months after the operation Patient was discharged from the hospital two weeks after the operation

Mobilization of the flap. The entire flap is now mobilized (fig. 1b). Its lateral half is mobilized by outside incisions, consisting of skin only. Its median

A

B

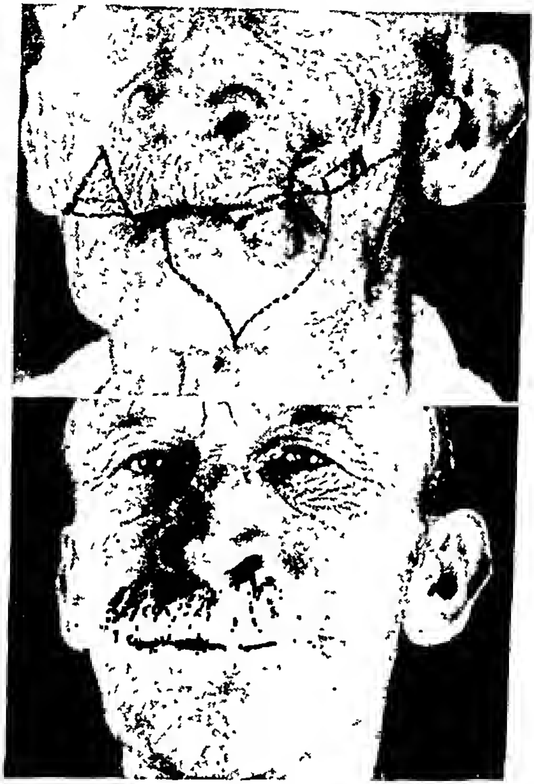


FIG. 3A. Patient, age 74, had a small aquamous cell carinoma in left half of lower lip which had been unsuccessfully treated with irradiation. Therefore, the left half of the lower lip was excised. The defect was covered with a flap rotated from the left nasolabial region. The histological examination, however, showed numerous carcinomatous cells at the edges of the excised part, at least ½″ away from the ulcer. Therefore, a more radical operation had to be performed. The patient in this figure is shown ten days after the first operation. He was now operated upon according to the Modified Dieffenbach Method on the left side, and Burow's Method on the right side. The heart-shaped excision is marked out. Note that one-fifth of the right lower lip was left intact, that the left side of the excision included considerable parts of the cheek. The defect was covered with a unilateral composite flap from the left side and rotation of the right cheek after triangular-shaped excision of the right nasolabial region with lengthening of the lip (Burrow).

FIG. 3B. Same patient ten months after the operation had heen carried out. He died twenty months after operation from cervical metastasis.

hafl is mobilized by inside incisions, comprising the entire thickness of the cheek. The incisions for the lateral half penetrate not deeper than to the *fascia parotideo-masseterica*, from which the lateral half of the flap is separated. The incisions

for the median half begin with separation of the mucous membrane along its reflection at the mandible and reach from the defect to the anterior border of the masseter muscle. This incision includes the mucous membrane only. The other inside incision leading vertically upward connects this latter point with the outer edge of the newly formed lip. This incision penetrates through mucous membrane and the muscles. The entire flap is now turned downward and by blunt dissection separated from the mandible until the submandibular spaces are exposed. This is an important step since the flap will not be flexible enough unless it is separated entirely from the mandible.

Closure of defects. Both flaps, which have surprising mobility, are shifted toward the midline into the defect. By doing this, a secondary mucous membrane and muscle defect is created in front of the masseter muscle, also a secondary skin defect where the lateral half of the flap was taken. To close the muscle and mucous membrane defect, I advise the following procedure: a flap of the masseter muscle, consisting of its anterior lower half, is separated from the underlying buccinator muscle and shifted anteriorly into the muscle defect (fig. 1c). The closure of all defects is now carried out in the following order: connection of the lateral edge of the new lip with upper half of the commissure; connection of the mucous membrane of the flap with the gums; closure of the posterior mucous membrane defect, as far as possible, by mobilization of the posterior mucous membrane lip; connection of both flaps to each other in a three layer suture; connection of the masseter flap to fill the defect; connection of the lateral half of the main flap with the skin edges; closure of the secondary skin defect by starting with closure of the lateral corner. This is easily accomplished since the outer angle has been made smaller than a right angle (Szymanowski) (fig. 1d). A drain is inserted in the lateral lower wound angle. The patient is fed through a Jutte tube.

If the tumor has involved the mandible, the mandible can be resected at the same sitting after proper preoperative splinting. Dissection of glands, however, should be done in a second stage.

The same operation can be performed unilaterally for unilateral lesions (fig 5); it is particularly of value for closure of those unilateral defects whose lateral borders reach beyond the angle of the mouth (fig. 4). If transplantation of such a unilateral flap is not enough to close the defect, it may be combined with the method of either Burow or Estlander at the other side (fig. 3).

I have applied the method on seven patients with extensive carcinoma of lower lip and chin. In one patient, the tumor had extended around the commissure and involved the lateral third of the upper lip. In four instances, a bilateral flap transplantation was performed; in one instance, a bilateral flap transplantation was combined with Burow's method; in one instance, a unilateral flap was combined with Burow's method on the other side; in one instance, a unilateral flap was used. In one case of a bilateral flap transplantation, a resection of the central part of the mandible had to be added followed by bone transplantation later. In two cases, regional lymph glands were subsequently dissected. The youngest patient was 34 years of age; the oldest 74 years. There was no opera-

FIG. 4E

FIG. 5. This patient had a cancer of the gum at the posterior part of the left mandible. The cancer was treated with irradiation elsewhere. Five months later he developed a large squamous cell carcinoma in the mucous membrane of the right half of the lower lip. The tumor was the size of a 25 cent piece. He still had evidence of marked necrosis from the former irradiation of the first tumor at the posterior part of the left mandible. To avoid further necrosis it was decided to remove the second tumor surgically. The right two-thirds of the lower lip and chin were excised, and the large defect covered with a composite cheek flap from the right side. Due to necrosis and adherence of the left cheek no tissue mobilization was possible there. The flap was under some tension but held well in place.
Patient shown six weeks after the operation.
Patient moved to another locality. No further information could be obtained.

CONGENITAL BANDS ABOUT THE SHOULDER GIRDLE

ADALBERT G. BETTMAN, M.D.

Portland, Oregon

The title of this paper is intended to include the various congenital conditions which involve webbing about the shoulders both above or below, that is, between the mastoid region and the acromion above, and the chest wall and the humerus in the axillary region below. The two are sometimes associated but may be entirely separate and distinct. The neck region will be considered first.

Anomalous stretching of the skin from some point about the ear to the point of the shoulder is the outstanding feature of this condition. It is as though a rope had been spanned across from one to the other and the skin then draped over it and allowed to hang in a graceful festoon. Thus the neck appears broad. This broadness increases the appearance of any shortness of the neck that may be present and makes it look short when such may not be the case. The skin is so loose antero-posteriorly that the victim may pick up the ridges of the festoons and pull them out giving a very grotesque appearance. Attempts to lay the skin up against the neck, as in normal individuals, meets resistance at once, which is increased by abducting the head to the opposite side. When one picks up the crest of the web between the finger and thumb, with the head toward the opposite shoulder, there is a feeling of resistance which is deeper than the skin itself. This webbed condition may be present in individuals who may or may not have other congenital abnormalities. It may involve only one side or have the same or different points of attachment on the two sides. The most emmon and perhaps the best known of these webbed conditions is the Klippel-Feil Syndrome. It may be present in what is called high scapula and also in arthrogryphosis multiplex congenita.

Webbing of the neck is known under various names such as pterigium colli, frog neck, dove neck, etc. Cervical rib may be present or hypertrophied transverse vertebral processes. The entire ear may be pulled down and the lobe webbed or the ear may be otherwise malformed. The head attachment of the webs may be in front or behind the ear, or may be in front of the ear on one side and behind on the other side. The latter was the condition in one of my patients.

The condition as first described in 1883 by Kobylinski (1) who noted that it may be related to congenital short neck and was struck by the similarity to the neck of the chimpanzee. He thought it might be an atavism.

Funke (2) in 1902 gave the condition the very picturesque and appropriate name of pterygium colli.

Bussiere (3) also in 1902 reported a similar case. However, all these presentations were rather incomplete.

In 1912 Klippel and Feil (4) reported a patient in which webbing of the neck was associated with congenital malformation of the cervical spine and this combination of conditions has since been called by their names. In the Klippel-

tive mortality. The oldest patient was discharged on the 7th post-operative day. The other patients were discharged between the 10th and 14th post-operative day. Primary healing resulted in all cases.

Various examples are depicted to demonstrate the technic, possibility, and versatility of the method, and also the satisfactory cosmetic and functional results. In all those patients it would have been impossible to close the large defect after excision of the tumor with the less extensive cheek rotating methods. Without the Dieffenbach operation available, lined flaps from distal parts would have been the only choice. I am convinced that flaps from distal parts would have been followed by less satisfactory results than the modified Dieffenbach operation offered.

SUMMARY

The modified Dieffenbach operation is described for closure of large defects of lower lip and chin. The principle involved in this operation is based upon the creation of a triangular defect which is closed by shifting one or two composite flaps from the immediate neighborhood into the defect around one point of rotation. This operation can be combined with other methods which use a rotation and shifting of full-thickness cheek flaps.

REFERENCES

Dieffenbach, J. F.: Chirurgische Erfahrungen. Abb. 3, u. 4, p. 101, Berlin, 1834.
May, H.: One-stage operation for closure of large defects of lower lip and chin. Surg., Gynec. & Obst., 73: 236, 1941.
May, H.: Closure of defects of lips with composite vermilion border-lined flaps. Ann. Surg., 120: 241, 1944.
Szymanowski, J.: Zur plastischen Chirurgie. Viertelj: Ztschr. f. d. prakt. Heilk., Prag., 60: 127, 1858.

bring into prominence the crest of the web. An incision is made along the then prominent ridge beginning close to the head and continuing almost to the acromion process. The incision is made down to the skeletal muscular layer which readily comes into view. A second incision is then made, at about a right angle to the first, on the tenser of the two sides of the wound, and a third on the opposite side. Usually these two right angle incisions are made in the regions of the one-third and two-third points on the length of the primary incision, one anteriorly and the other posteriorly. The end result depends upon the accuracy of judgment as to location and direction of these lateral incisions. The choice as to whether the upper incision should be anterior or posterior depends on which will give the smoothest closure with the greatest narrowing of the circumference of the neck, that is, the greatest relief from the disfigurement and the nearest approach to a normal neck contour. At the same time the location of the incisions will determine the new location of the hairline. Usually it should be raised so as to give the illusion of greater neck length. Thus the upper incision is made posteriorly and the lower one anteriorly. All incisions go through the subcutaneous layer and connective tissue bands to the muscular layer and the flaps are widely undermined. These right-angle incisions are an inch and one-half or more in length, depending upon the amount of lengthening necessary trasversely and of narrowing possible antero-posteriorly. These details are determined by the amount of skin available and by the position of the deeper muscles. When the transverse incisions have been made and the skin properly undermined the head may be abducted to the opposite side to a much greater degree than before.

When the desired increase in mobility has been accomplished and the transverse incisions have been made at the correct locations, the point of one flap of skin will automatically fall into the angle of the opposite incision and the other will do likewise giving the smooth closure that is usual in such zigzagging procedures. One or more additional similar but shorter right angle incisions are made, above or below or both, as may be indicated. Thus additional length is obtained when needed. It is now possible for the patient to abduct the head to the opposite shoulder in a normal or near normal manner. The wound is closed with the usual sutures. The same procedure may be carried out at the same sitting, on the opposite side when this requires correction also. Voluminous dressings held on by bandaging hold the lengthened skin against the deep muscles of the new neck line until healing has been completed. When applying such a dressing, the larynx must be well padded or great distress follows. The scars are usually inconspicuous.

MacCollum recommends a method of operation which consists of transposing large anterior and posterior flaps of skin and subcutaneous tissue as in a Z plastic. This may not give as much relaxation as does the method detailed above.

The right angle incisions especially must be made with circumspection for the spinal accessory nerve runs at a right angle to this incision as it lies on the splenius muscle. Also large vessels may be encountered particularly under the

Feil syndrome the deformity usually consists of a coalesence of the individual segments of the cervical vertebrae together with a spanning of the skin between the mastoid and the acromion.

Drachter (5) in 1923 wrote of a patient with what he termed "dove neck." It was associated with osteomyelitis. There may have been deformities of the bony parts in his patient.

In 1925, Frawley (6) was the first to report the condition as occurring in more than one member of the same family, at which time he cited it in two sisters and in two other patients. In all four the cervical spines were normal as shown by Roentgenograms. In one there was webbing of the axillary folds.

In 1928, de Bruin (7) presented an infant with webbing, in whom there was no abnormality about the cervical spine. Shortly thereafter the child died of an independent condition. At autopsy the material was carefully studied. He decided that the skin was too short in the perpendicular direction.

In 1934, Nagcotte and Wilbouchevitch (8) reported three cases in women and proposed that some endocrine disfunction was the cause of the deformity.

Chandler (9), in 1937, reported a patient and was the first whose writings can be located to definitely describe an operation for the correction of the webbing, by transposing V-shaped flaps as in zigzagging. There are references in the literature to other operations but no details are given by any of the authors.

Also in 1937, Turner, Shoulders and Scott (10) reported a patient with this deformity. MacCollum (11) reported in 1938 that after studying four patients and several fetuses he concluded that the webbing is due to lack of development of the neck skin of the fetus between the time the head is wider than the shoulders and the time the shoulders become normally wider than the head. Bizarro (12) also in 1938 wrote of a case of this kind. Hauptmann and Thannhauser (13) in 1941 distinguished this type of webbing from that due to shortened muscles and dystrophy which they discussed in detail.

Irrespective of the concomitant bony malformations, the presence of the neck deformity caused by the webbings bring the patient to the plastic surgeon. The disfigurement is very great and the patients are distressed by their frog-like appearances.

The correction of the condition is quite simple. In many patients the correction is so good that there is little or no deformity, while in others this degree of correction is not possible. It is limited by the positions of the trapezius, splenius colli, levator anguli scapulae and the scalenus posticus muscles.

Authorities do not agree as to the pathology of the condition. When the skin is incised one is struck with the peculiar nature of the subcutaneous tissues in that there is a marked increase of the connective tissue elements under the skin and in some patients considerable muscle tissue is intersperced very near the surface. This increase in connective tissue extends through all the structures down to the skeletal muscles of the neck and is present as long, heavy, bands running parallel to the line of the stretched web.

The operation as we do it is performed as follows: Local anaesthesia is preferred. The head is pushed toward the opposite shoulder, not turned, so as to

Fig. 1 Fig. 2

Fig. 1. Case 1. E. M., Original Condition with Webs of All Articular Areas, and Club Feet

Fig. 2. Case 1. E. M., Showing the Neck Webs Extended

Fig. 3 Fig. 4

Fig. 3. Case 1. E. M., Same Condition Several Years Later

Fig 4. Case 1. E. M., The Neck and Axillary Regions after Operations

was relieved as was also the pull on the eyelids and mouth. Undoubtedly there was some endocrine dysfunction also present in this patient, either as a causitive factor or as a complication.

anterior flap. Three such patients were operated upon on both sides in the manner described and one on one side only.

The second condition within the title of this paper is congenital bands extending from the chest wall to the humerus. This condition may be associated with the absence of one or both of the pectoral muscles and with webs of the neck. The dense connective tissue web, as it stretches across, is covered only by the two layers of thin skin, one anteriorly and one posteriorly, with little subcutaneous fat.

These patients, usually children, are prevented, by the web, from externally abducting the arm, perhaps even to a right angle. In order to raise it further they swing it forward. In some patients there is absence or underdevelopment of the deltoid muscle.

These patients are operated upon in a similar manner to that described for the neck condition. There is no excess skin and none must be removed. The incision is made the full length of the web along its crest. The two layers of skin are separated by dull dissection from the thin but strong fascial band which lies between them. The dissection extends up into the axilla and from the humerus to the ribs until the fascial band is fully exposed. The band is then severed close to its attachments at both ends and is removed.

The fascial band having been removed, incisions are then made through the skin at right angles to the first incision as previously described. The transverse incisions are made long enough to allow the arm to be completely externally abducted. As in the neck operation, the lines of the incision fall together when put on the stretch. Additional lateral incisions are made above and below, until full and complete external abduction with the arm up alongside the head is obtained. This position is maintained until healing is complete. Two such patients will be reported.

Case 1. E. M., age 14 years, was seen at Shriner's Hospital, September 9, 1936. She had congenital webs of practically all articulating areas of the body, including the neck anteriorly as well as laterally, the axillae, the cubital areas, the popliteal regions and the crotch. The external angles of the eyes were pulled downward and outward and the mouth was pulled backwards. The webs of the neck were dissimilar on the two sides. This child may be designated pterygium universalis or multiplex. In addition, she had club feet and a cleft palate. The condition of the feet had been corrected before we saw her.

The right axilla was operated upon first according to the method described above and the arm brought up to the normal abduction position, a splint being applied to hold it there. The wound healed nicely and one week later the left side was corrected in a similar manner. It was noted that there were many abnormal fibrous bands under the skin which it was necessary to sever. Nineteen days later the right neck region was operated upon. The ear which had been pulled down and the webbed lobe were both released by the operation on the neck. Twenty-four days after this operation the left neck web was lengthened, the incision zigzagged and the wound sutured in a similar manner. All wounds healed nicely. Two weeks later the neck anteriorly was operated upon by transposing two V-incisions. This did not heal as smoothly as the lateral wounds.

The method making the lengthwise incision first gives greater lengthening. All wounds were entirely healed and the patient discharged after the five operations, 102 days after the first one, greatly improved in appearance and function. Radiographs were not obtained. The neck was narrowed in its circumference by the operations, the arm condition

Fig 8

Fig 9

Fig 10

Fig 8 Case 3 D C, The Webs on Both Sides before Operation
Fig 9 Case 3 D C, The Webs Extended
Fig 10 Case 3 D C The Patient after Operation on Both Sides The Scars Are Very Small

FIG. 5

FIG. 6

FIG. 5. CASE 1. E. M., THE WEBBING AS IT EXTENDS IN THE MASTOID REGION, ON THE LEFT

FIG. 6. CASE 1. E. M., THE WEB IN FRONT OF THE EAR ON THE RIGHT

FIG. 7. CASE 2. J. C., NECK WEB ON THE LEFT SIDE ONLY

Fig. 14

Fig 15

Fig 16

Fig. 14 Case 6 D S, Webbing of the Left Axillary Region as Viewed from the Side

Fig 15 Case 6 D S, As Viewed from the Front

Fig. 16 Case 6. D S, Shortly after Operation No Skin was Removed

FIG. 11. CASE 4. W. M., APPEARANCE AFTER OPERATION. SCARS ARE VERY SMALL

FIG. 12

FIG. 13

FIG. 12. CASE 5. R. G., THE AXILLARY WEBBING ON THE RIGHT BEFORE OPERATION
FIG. 13. CASE 5. R. G., SHORTLY AFTER OPERATION SHOWING THE ZIGZAGGING. NO SKIN WAS REMOVED

9. CHANDLER, FREMONT A.: Webbed neck (pterygium colli). Am. J. Dis. Child., 53: 798–803 (Mar.) 1937.
10. TURNER, E. L., SHOULDER, H. S. AND SCOTT, L. D.: Klippel-Feil syndrome with unusual clinical manifestations. Amer. J Roentgenol., 40: 43–46 (July) 1938.
11. MACCOLLUM, DONALD W.: Congenital webbing of the neck. New Eng. Jour. Med., 219: 8 (Aug.) 1938.
12. BIZZARRO, A.: Lancet, 2: 828–829 (Oct. 8) 1938.
13. HAUPTMANN, A., AND THANNHAUSER, S. J.: Muscular shortening and dystrophy: a heredofamilial disease (with "webbed neck"). Arch. Neurol. and Psychiat., 46: 654–664 (Oct.) 1941.
14. SYLVEST, O.: Pterygium colli combined with Thiemann-Fleischner disease and abnormality of patella; case. Ugesk. f. Laeger, 102: 1270–1272 (Nov.) 1940.
15. CAPURRO, A. M.: Turner syndrome as new clinical form of infantilism; infantilism, webbed neck and cubitus valgus, with report of case. Dia Med., 13: 124–126 (Feb. 24) 1941.
16. BELGRANO, C., ROSSI AND CAPURRO, A. M.: Turner syndrome (infantalism, congenital webbed neck and cubitus valgus). New case. Semana med., 1: 644–648 (Mar. 13) 1941.
17. TURNER, H. H.: A syndrome of infantilism, congenital webbed neck, and cubitus valgus. Endocrinology, 23: 566–574 (Nov.) 1938.
18. MARQUARDT, W: Congenital webbed skin and its conservative treatment. Two cases. Ztschr. f Orthop., 67: 379–386, 1938.
19. HOFFMAN, H.: Pterygium colli in relation to multiple malformations; three cases. Arch. f. Kinderh., 110: 1–24, 1937.
20. RANTASALO, V.: Congenital pterygium of neck and elephantiasis; case. Acta Paediat., 368–375, 1936.

Case 2. J. C., age 13 years, was seen also at the Shriner's Hospital, April 13, 1938. He had pterigium colli of the left side. The right was also involved but was of so little consequence that it was not operated upon. The web on the left side extended from the mastoid process to the acromion involving the skin and subcutaneous tissue. The operation was done under local anaesthetic. Transverse and right angle incisions were made as described with additional ones as indicated. When completed, the head could be brought over to the opposite side. The resulting scar was small.

Case 3. D. C., age 12 years, also seen at Shriner's Hospital, had webbing ol both sides of the neck. Otherwise she was normal. She was operated upon under ether anaesthesia, the pull on both sides being released. When completed, the head could be brought to the opposite shoulders in a normal manner.

Case 4. W. M., age 14 years, had moderate webbing of both sides of the neck. He was operated on under local anesthesia and the webs on both sides released. The increased function given him is considerable.

The webs about the axillary region occurred in two cases.

Case 5. R. G., age 4½ years, had webbing extending from the right third and fourth ribs at the anterior axillary line to the anterior bicipital ridge. This was operated upon as described in the body of this article completely removing the disability.

Case 6. D. S., age 5 years, had a similar condition on the left extending from the second rib to the anterior bicipital ridge. The result here also was excellent and the axilla was restored to practically normal contour and function.

There is nothing that can be done to restore absent muscles but these patients seem to get along very nicely with the absence of either one or both pectoral muscles.

CONCLUSIONS

Four patients having webbings of the occipital to the acromion regions have been described and a method of correction described; also two patients with webbing in the axillary region only have been presented and means of correcting both types of deformities are described.

629 Medical Arts Bldg.

REFERENCES

1. Kobylinski, O : Muscle shortening. Arch. Neurol and Psychiat., 46: 4, 1941.
2. Funke: Pterygium colli. Deutsche Ztchr. f. Chir, 63: 162–167, 1902.
3. Bussiere, J. A.: L'homme au cou de capelle, developement anoumal d'un faisceau mucsulaire acromie-mastoiden rudimentaire, malformation congenitale rare, observee a Pondichery (Indes Ouent ales). Ann. d'hyg. et de med., Colon, 5: 686–688, 1902.
4. Klippel, M., and Feil, A.: Un cas d'absence des vertebres cervicales avec cage thoracique remoutant jusqu a la base de cranc (cage thoracique cervicale). Nouv. iconog de la Salpetriere, 25: 223–250, 1912.
5. Drachter, R.: Demonstration. Klin. Wchuschr., 2: 664, 1923.
6. Frawley, John M.: Congenital webbing. Am. J. Dis. Child., 29: 799–805 (June) 1925.
7. De Bruin, M.: Pterygium colli congenitum. Am. J. Dis. Child., 36: 333–340, 1928.
8. Nageotte and Wilbouchevitch: Trois observations de malformations de la peau du cou replis cutanes lateraux: "pterygium colli congenitum," replis lateraux et posterieurs; dermatoptose sous-maxillaire. Bull. Soc. de pediat de Paric, 32: 683–688 (Dec.) 1934.

lingual nerves to the facial nerve has been reported many times but the number of satisfactory cases has been minimal. One of the distinct disadvantages is the necessity of associated distorting movements necessary to produce contraction of the facial group of muscles.

During the past decade there has been a definite trend toward the use of fascia strips. In most cases fascia strips give merely a stationery support. Blair (2) and Brown (3) report the use of fascia attached to the body of the temporalis muscle. Separate strips are brought down to support the eyelids, the nasolabial region, and the angle of the mouth. Neal Owens has used fascia strips to muscles of the mouth and lower third of the face, attaching the fascia loops into the body of the masseter muscle, and has been able to obtain support plus motion to the affected areas. Schussler has reported the use of tantalum wire attached to the temporalis muscle. The disadvantage in this procedure is that the wire is likely to cut through the tissues and there have been cases where the wire has broken.

The utilization of muscle transplant is not new. As far back as 1867 Lexer reported the use of the masseter muscle to give support and function to the region about the mouth by use of the intraoral approach. Hans Brunner (4) reports a similar operative procedure. Jianu (5) and Eden (6) report the use of the masseter muscle for support and function about the mouth by using the extraoral approach. Halle (7) and Alexander (8) also report the use of masseter muscle transplantation through an external incision at the lower border of the mandible.

Gillies in London and Sheehan in New York were the first to popularize the use of temporalis muscle flaps. The detached portion of the muscle starting at its point of insertion is brought downward in several strips. One flap is inserted into the frontalis muscle, one into both the upper and lower eyelid, and one or more attached around the angle of the mouth. In some cases Sheehan removes a section of the zygomatic arch to give an unhampered and straighter pull to the muscle flaps.

In paralysis of the facial nerve there is a loss of function of eleven major and nine minor muscles of expression about the face, eye, nose and mouth. Utilization of muscles with a different nerve supply is the only available means of restoring motion to this extensive area of paralysis. The substitution of one muscle to satisfactorily carry out the work is too much to expect. By the use of muscles from different locations about the face, muscle pull in various directions may be accomplished and more nearly normal motion obtained.

The masseter muscle is the most ideally located for giving motion to the lower half of the face. When the lower end of this muscle is swung forward to the region about the mouth a backward and slightly upward pull is achieved. A more natural effect is obtained than when the temporalis muscle is transplanted in this area, as its pull is largely upward and only slightly forward.

The temporalis muscle is the most suitable to aid in restoring motion and to give support to the eyelids. In this area the masseter would have the tendency to give a downward pull, whereas the temporalis provides the slightly upward pull which is required.

THE USE OF THE MASSETER, TEMPORALIS AND FRONTALIS MUSCLES IN THE CORRECTION OF FACIAL PARALYSIS

Lieutenant Commander WM. MILTON ADAMS[1]

Medical Corps, United States Naval Reserve

Numerous techniques with varying results have been reported utilizing muscle transplantation in the correction of facial paralysis. Many of these have been far from satisfactory. However, since nerve grafting is impossible in so many of these cases at the present time, some form of muscle substitution is our only hope for giving these patients not only support but the maximum amount of motion to the paralyzed side of the face. Certainly, study and investigation should be continued until a technique is established whereby these results can be obtained consistently.

In the reconstructive centers of both the army and the navy such a large number of satisfactory and encouraging results have been obtained in extremity work that it has given an increasing impetus to utilize muscle substitution in facial paralysis. The transplantation of flexor muscle tendons to do the work of the extensors has, in many cases, elicited results which are nothing short of startling. In some instances one is unable to offer any explanation for the surprisingly good results obtained. From a neurological standpoint many cases are unexplainable. Surprisingly enough the intelligence of the patient appears to have no bearing on his ability to re-educate and utilize the transplanted muscle.

Two cases are reported to give further evidence of the effectiveness obtained by muscle substitution, by the use of muscle flaps, in the correction of facial paralysis. It is obvious that this procedure does not give perfect results. It is a compromise at best. However, muscle transplantation not only gives the same support accomplished by fascia strips, but in addition affords voluntary motion without the distorting movements associated with nerve substitution.

The use of fascia strips may give a better primary result, but in some instances there is a tendency for the fascia to relax with a return of sagging in the affected area. The function of transplanted muscle improves as the patient reeducates the muscle and its tone increases. It offers the most to the patient where nerve regeneration is hopeless and is a worthwhile procedure in the case where nerve regeneration might take place at a later date.

The best results are obtained in acute facial paralysis cases where the nerve endings are sutured immediately or within the first few weeks following injury. There is some evidence to indicate that the optimum time is between the 19th and 25th day, as the cellular activity is at its height during this period. Nerve grafting has been most successful in the few cases where there is only a small gap in the facial nerve in the fallopian canal (1).

Transplantation of the hypoglossal, spinal accessory, glossopharyneal and

[1] *Chief of Plastic Surgery Department, United States Naval Hospital, Oakland, California.*

is obtained through a vertical incision, about one and one-half inches in length, in the temporal region inside the hairline just above the zygomatic arch (fig. 2). In selecting the point of incision the temporal artery is located by palpation and the incision made to one side, usually anteriorly. The muscle flap is constructed by making two vertical incisions about one-half inch apart. The over-

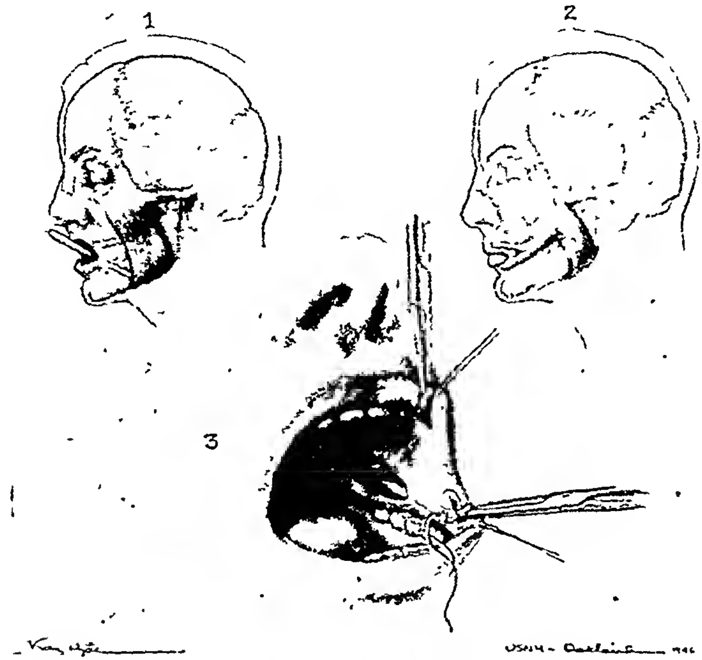


FIG. 1. TRANSPLANTATION OF THE MASSETER MUSCLE TO THE REGION ABOUT THE ANGLE OF THE MOUTH

(1) Freeing the masseter muscle from its insertion along the lower border of the mandible through an incision in the buccal mucosa (2) The masseter muscle flap divided at its distal end and swung anteriorly to the region about the mouth (3) The muscle flap being threaded through the formed tunnel beneath the mucous membrane of the mouth into the body of the orbicularis oris muscle of the upper and lower lip The ends of the flaps are sutured as near the midline of the lips as possible A third suture is placed at the lateral border of the orbicularis oris muscle where it conjoins with the risorius to bring out the nasolabial expression line

lying temporal fascia is left attached to the muscle which is to form the flap. In order that a minimal amount of the nerve supply be disturbed one should adhere closely to the body of the temporalis muscle. This should be done by blunt dissection A long slender pair of scissors with an acute angulation of the blades at the end is used in severing the muscle attachment from the coronoid process of the mandible. A tunnel is formed from the temporal region over the outer rim of the orbit across the upper and lower eyelid to the canthal region. If the temporalis muscle flap is not of sufficient length to reach the inner canthal

For reanimation of the paralyzed eyebrow and forehead region an excellent result may be accomplished by simply shifting a flap of the lower insertion of the frontalis muscle just across the midline of the forehead. This elevation is obtained without depending on the possibility of reactivating the paralyzed frontalis muscle as is the case when the temporalis muscle is substituted in this area.

In the transplantation of muscle flaps there are a few pertinent points in technique which it is well to bear in mind. It is important that flaps of adequate size be used to supply necessary strength and support to the paralyzed region. Secondly, although sufficient tautness is necessary for a satisfactory result, care should be taken to avoid undue stretch which might cause ischemia of the muscle bundles. Thirdly, it should be kept in mind that too much angulation of the pedicle might interfere with its circulation. The procedure may result in failure if these factors are not fully appreciated.

TECHNIQUE

In transplanting the masseter muscle either an intraoral or extraoral approach may be used. Unless the muscle is unusually small the intraoral approach is preferable. The operation is done under local anesthesia as it is helpful to have the patient contract the muscle by clenching his teeth during the dissection of the muscle flap. This brings the muscle forward from its deep bed in the cheek up against the buccal mucous membrane along the anterior border of the masseter, the muscle is immediately brought into plain view (fig. 1). The anterior third or half of the muscle is detached from its insertion at the lower rim of the mandible. It is important to detach it as low as possible in order to obtain a flap of adequate length, and to utilize at least one third to give a flap of sufficient strength.

A small incision is made in the mucous membrane of both the upper and lower lip just lateral to the midline and through each of these incisions a tunnel is formed through the body of the orbicularis oris, the tunnels meeting at the lateral rim of the orbicularis oris muscle. The tunnel is continued backward from this point to the masseter region just beyond the buccal mucosa.

The distal end of the muscle flap is divided into two halves for a distance of one inch and the pedicles brought forward through the formed tunnel. One half is attached into the body of the orbicularis oris of the upper lip and the other half into the lower lip, at a point near the midline.

To aid in restoration of the nasolabial fold, it is well to place a suture in the muscle flap attaching it to the orbicularis oris at the point where it conjoins with the risorius muscle. It may be necessary to make a very small incision in the mucous membrane at this point.

The size of the masseter muscle varies considerably in different individuals. In the few cases where the muscle is unusually small or is attached rather posteriorly at the angle of the mandible the intraoral approach may be a little difficult. In such cases the extraoral approach through an incision along the lower border of the mandible is preferable.

To give support and function to the eyelids, a pedicle of the temporalis muscle

superioris muscle. A period of four to six weeks elapses before the patient actually gets active contraction of the transplanted muscle flap.

The transplantation of the frontalis muscle is carried out through two incisions about one-half inch in length at the inner border of each eyebrow just below the

FIG 3 SHOWING THE TRANSPLANTATION OF THE FRONTALIS FLAP TO THE OPPOSITE EYEBROW REGION

(1) and (2) show two small incisions at the inner border of the eyebrow just below the hairline and the area of skin of the central portion of the forehead undermined at the donor site of the frontalis flap. (3) and (4) show the flap being swung over to its new location and the point of fixation of the distal end.

hairline (fig. 3). Through these incisions the skin overlying the middle third of the forehead is completely undermined. An incision is made under the skin down to the periosteum in the midline of the forehead from the hairline downward to the glabella region. From this point the medial one-third of the frontalis

region this needed length may be obtained by reflecting down a portion of the overlying fascia.

The distal end of the pedicle is split for a distance of one to one and one-half inches, one-half being used for each eyelid. The pedicle is threaded through the formed tunnel and the two ends sutured into the region of the inner cantha

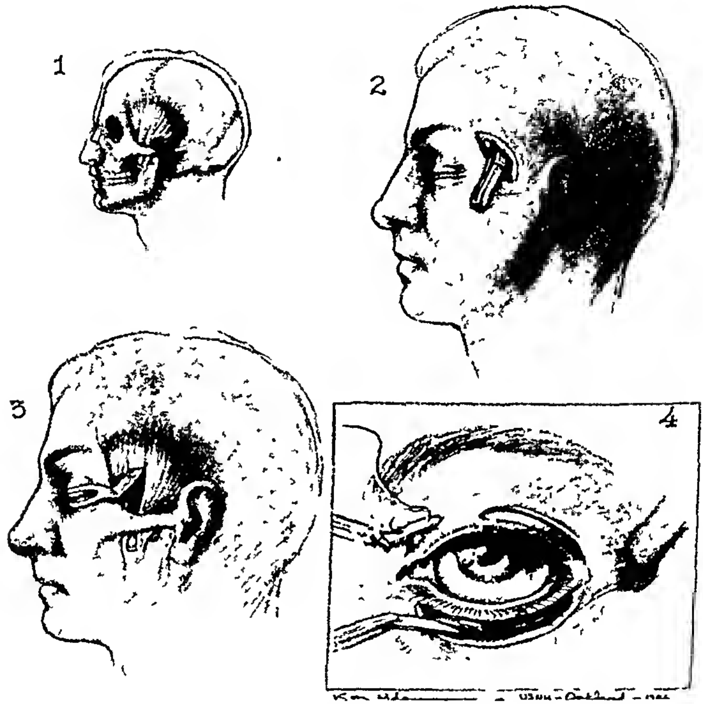


FIG. 2 TRANSPLANTATION OF A FLAP OF THE TEMPORALIS MUSCLE TO THE EYELIDS
(1) The location and amount of temporalis muscle used to form a flap (2) The freed temporalis muscle flap with overlying fascia intact (3) The overlying fascia reflected down from the body of the muscle to give needed length to reach the inner canthal region and divided to give a strip for both the upper and lower eyelid (4) Shows the flaps threaded through the eyelids and the ends sutured in the inner canthal region

ligament The use of a malleable dissecting probe is of aid in delivering the muscle flap through the tunnel, a thread being tied around the ends of the flap and threaded through the eye of the probe.

It is striking to note that immediately upon completion of the operation the patient is able to open and close the eyelids This is not the result of an actual contraction of the temporalis muscle but is due only to the tautness of the flaps which have been threaded through the upper and lower eyelids. They automatically pull the eyelids together upon relaxation of the levator palpebrae

ι b

› (a) Preoperative Photograph Showing Asymmetry of Face Drooping of Wide Left Palpebral Fissure, Drooping Left ing of Mouth to Right. (b) Six Months Post-operative e in Normal Relaxed Position

b

reoperative Picture Showing Marked Asymmetry of \ with Patient Trying Desperately to Close Left ative Picture Showing Patient Able to Completely Left Corner of Mouth. Nasolabial Fold Defi-

ear to give support to the left side of the mouth. Re-
including electrical stimulation, revealed no evidence
as the opinion of the neurological department that

muscle is severed at its lowest attachment in the eyebrow region. In pedunculating the muscle the fibres are separated vertically. Blunt dissection is used to avoid cutting any more of the nerve fibres than necessary. The muscle is divided only high enough to permit the distal end of the pedicle to be shifted across the midline into the opposite eyebrow region. It is then sutured in place into the the body of the orbicularis oculi superciliaris muscle with two 5 (0) chromic catgut sutures.

In all three of the muscle transplant operations an elastic pressure bandage is worn for approximately one week to prevent postoperative hemorrhage and undue swelling of the tissues. The patient is not encouraged to attempt motion of these muscles for a period of eighteen to twenty-one days following operation. From this time on the patient is encouraged to spend time daily attempting to re-educate the transplanted muscles. Practicing before a mirror is helpful and it is important that the patient be instructed in the motions through which he will be able to bring these muscles into play. Faradic and Galvanic stimulation should be given for a few minutes daily to aid in reactivating the muscles.

Although three muscles are used in an effort to give as much motion as possible to the parlayzed side of the face the results are far from perfect but it is felt that they are superior to those obtained in the usual supportive operations, and in the case where only one muscle is utilized. In each of the three operations the origin of insertion of the muscle is pedunculated. Physiologically and mechanically this interferes the least with the donor muscle with reference to its circulaton, nerve supply and direction of pull.

In the treatment of facial paralysis by muscle substitution where every available active muscle is fully utilized, even better results can be hoped for. Certainly it is worthy of further study and investigation.

CASE REPORTS

Case 1. B. F. S., female, aged twenty-one years. Complete facial paralysis, left side (figs. 4(a) and (b)). In the neurosurgical department at the U. S. Naval Hospital, Oakland, California, August 22, 1945, the patient had a neurofibroma removed from the left eighth nerve. The neurofibroma was a large capsulated tumor located beside the brain stem and extending from the temporal notch to the medulla region. The seventh nerve throughout this region was sacrificed in the removal of the tumor. The patient had an uneventful recovery from the operation except that permanent paralysis of the acoustic and facial left side resulted.

The patient wore a plastic support hooked into the corner of the mouth and attached around the left ear until she was referred to the plastic surgery department on September 5, 1945 for operation to give support to the left side of her face. On September 20, 1945, under local anesthetic, a pedicle of the temporalis muscle was transplanted to the eyelids. The muscle flap, about ⅜-inch in diameter and 2½ inches in length, was obtained from the anterior third of the temporalis muscle which was dissected from its insertion at the head of the coronoid process of the mandible. A tunnel was made under the skin over the malar bone and across the upper and lower eyelids. The muscle flap was delivered through a constructed tunnel, to the eyelids. The distal one inch of the pedicle was split in half and each end sutured into the mid portion of the orbicularis oculi of the upper and lower eyelid, near the mid portion.

About three weeks following operation it was first noted that the patient slept with the

a b

FIG. 6 (a AND b). CASE 2. (a) PREOPERATIVE PHOTOGRAPH SHOWING ASYMMETRY OF FACE IN RELAXED POSITION. DROOPING OF WIDE LEFT PALPEBRAL FISSURE, DROOPING LEFT SIDE OF FACE AND PULLING OF MOUTH TO RIGHT. (b) SIX MONTHS POST-OPERATIVE PHOTOGRAPH WITH FACE IN NORMAL RELAXED POSITION

a b

FIG. 7 (a AND b). CASE 2. (a) PREOPERATIVE PICTURE SHOWING MARKED ASYMMETRY OF FACIAL MUSCLES OF EXPRESSION WITH PATIENT TRYING DESPERATELY TO CLOSE LEFT EYE. (b) SIX MONTHS POSTOPERATIVE PICTURE SHOWING PATIENT ABLE TO COMPLETELY CLOSE LEFT EYE AND RETRACT LEFT CORNER OF MOUTH. NASOLABIAL FOLD DEFINITELY FORMED

the mouth attached around his left ear to give support to the left side of the mouth. Repeated neurological examinations, including electrical stimulation, revealed no evidence of facial nerve regeneration. It was the opinion of the neurological department that

eyebrow region, is not completely satisfactory (figs. 5 (a) and (b)), credit for the motion she does have to the left side of her face must be given to transplant operation. Without doubt this is a case of complete, permanent paralysis with no possibility of return of function. When the patient is in a relaxed position signs of facial paralysis are not obvious since both sides of the face are almost bilaterally symmetrical.

a b

FIG. 5 (a AND b). CASE 1. SIX MONTHS POSTOPERATIVE PICTURES. (a) SHOWING PATIENT WITH EYE ALMOST CLOSED AND FACE BILATERALLY SYMMETRICAL IN RELAXED POSITION. (b) PATIENT WITH EYES OPEN, SMILING SLIGHTLY, SHOWING THE TWO SIDES OF THE FACE PRACTICALLY BILATERALLY SYMMETRICAL

Case 2. J. E. S , Cpl. USMCR, aged 22 years. Complete facial paralysis, left side. On May 12, 1945, this patient received a through and through gunshot wound of the head by a sniper's bullet on Okinawa. The patient states that he did not lose consciousness but was totally blind for one day. Vision returned completely in his right eye but remained blurred in the left. He was completely deaf in the left ear, was bothered with tinnitus in the left ear and had a slightly staggering gait. The point of entry of the bullet was just below the left eye, ranging through the left side of the face, through the inferior portion of the malar and through the facial canal, with its exit through the left mastoid region.

The patient was taken to a field hospital where the wound was debrided and drained. Roentgenograms revealed a comminuted fracture of the left malar bone, the lateral wall of the left maxilla, the neck of the condyle of the mandible and the left mastoid process. There is no previous history of paralysis or any sensory disturbance.

On June 26, 1946, the patient was admitted to the U. S. Naval Hospital Neurological Service, Oakland, California. Physical examination at this time revealed a healed scar of a bullet wound below the left eye and a healed scar behind the left ear. Neurological examination revealed complete left facial paralysis (figs. 6(a), 7(a), 8(a)). The left pupil was dilated and fixed with decreased vision in the upper half of the left visual field, and a massive white area in the lower outer quarter of the retina. There was a loss of sensation of the cheek below the bullet wound covering an area of approximately 3 inches in diameter, total loss of hearing in the left ear and some weakness in the muscles of mastication on the left side. No other cranial nerve signs were elicited. The right side of the face was normal.

For a period of four months the patient wore an extraoral plastic hook in the corner of

To prevent undue swelling of the buccal region and discomfort to the patient, and to prevent the mucous membrane of the mouth from pushing between the upper and lower teeth, a thin Stint mold of dental wax was inserted between the teeth and the soft tissue of the cheek. This was left in place for several days following operation. After one week the pressure bandage was removed.

After a period of six weeks the patient had good support to the lower half of the face and considerable controlled contracture about the corner of the mouth. He was also able to close the eyelids.

The most noticeable disfigurement at this time was the paralysis of the left half of the patient's forehead and eyebrow region. To give support and possible motion to this area, a flap of the right frontalis muscle about ½ inch wide was detached from its insertion and swung across to the paralyzed side where it was attached into the body of the orbicularis occuli superciliaris muscle and the lower portion of the paralyzed frontalis muscle. Although the patient had satisfactory support of the lower eyelid immediately following operation, and the lids remained closed when sleeping, the patient was cautioned against exerting the muscles of mastication during the first two weeks following operation. After this period he was instructed to start trying to re-educate these muscles by clenching his teeth in an effort to close the eyelids. By the end of the third week when the patient clenched his teeth tightly he could partially close the eyelids.

The function of the eyelids increased progressively from this point on, and by the end of the fifth week he was able to close the eyelids at will.

The patient had no controlled contracture about the corner of the mouth for a period of four weeks. In an effort to re-educate the muscle he spent a good deal of time practicing before a mirror. The first motion about the corner of the mouth was noted about the end of the fourth week and, interesting to note, though unexplainable, the only way he could produce motion at the corner of the mouth was by clenching his teeth and wriggling the right ear at the same time. After about one week he was able to obtain motion without wriggling his ear and his ability to produce contracture at this point showed progressive improvement. From the third postoperative week the transplanted muscles were stimulated daily with Faradic and Galvanic electrical currents.

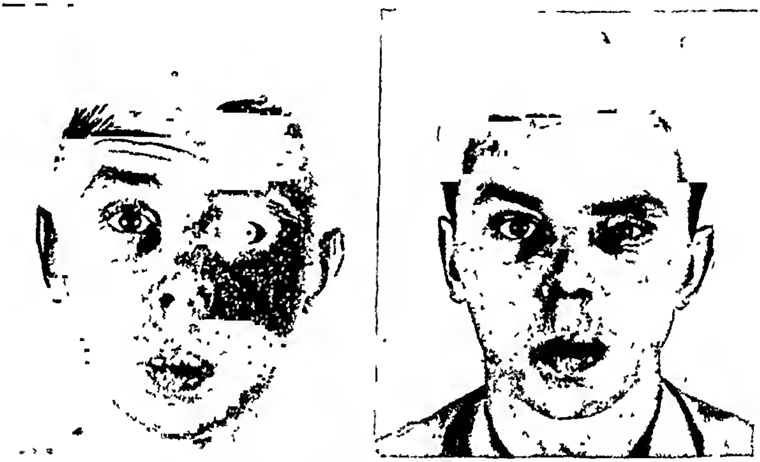
Nine weeks elapsed before any motion was noted in the eyebrow region. This was only a slight twitching of the inner half of the eyebrow obliquely upward and medially. About four weeks later there was such an extreme elevation and arching of the right eyebrow which produced such a marked contrast of the two halves of the forehead, that to lessen the contrast a small stab wound was made with a No. 11 Bard Parker knife blade about ½ inch above the middle third of the right eyebrow in the skin of the forehead. The greater proportion of the frontalis muscle was incised *horizontally* down to the *periosteum* and a pressure bandage applied. This did not give the improvement hoped for but did decrease some of the over contracture of the frontalis. The contracture of the frontalis pedicle is still not marked at this time (six months following operation) but the eyebrows when at rest are bilaterally symmetrical and motion is still improving.

From the fourth month there has been very little visual improvement in the motion of the eyelids and the region about the corner of the mouth. Up until six months following operation the patient could only close his eyelids and contract the corner of the mouth by clenching his teeth Figs. 6(b), 7(b), 8(b). At the end of six months he found that with his mouth open he could retract the left side of the face by holding his muscles of mastication tense.

Electrical stimulation to the facial nerve was completely negative until seven months following operation. At this time it was first noted that on Faradic current stimulation of the facial nerve, just anterior to the mastoid process, there was a slight movement of the muscles of expression of the lower half of the face indicating that there is a very slight regeneration of the facial nerve to this group of muscles. As to what extent regeneration of the nerve will continue to increase is difficult to predict. Whether it does increase or

paralysis was of a permanent nature due to extensive injury of the facial canal. The patient was transferred to the plastic surgery department for either fascia sling or muscle transplantation to the paralyzed group of muscles.

On November 11, 1945, under local anesthesia, a flap of the temporalis muscle about ½ inch in diameter and 3 inches in length was dissected from the head of the coronoid process, through a vertical incision in the temporal region. A tunnel was made under the skin over the malar bone and across the upper and lower eyelids. In order to give sufficient length to the pedicle so that it might reach the inner canthal region, the fascia of the muscle flap was reflected down and split into two parts, one for each eyelid. In the first case we depended entirely on the temporalis muscle flap which only reached the mid portion of the eyelid, and although it gave considerable improvement in supporting the lower eyelid and in aiding the patient to close the eyelids, the results were not completely satisfactory.



a b

FIG. 8 (a AND b). CASE 2 (a) PREOPERATIVE PHOTOGRAPH SHOWING MARKED ASYMMETRY WITH PATIENT ATTEMPTING TO WHISTLE. (b) SIX MONTHS POSTOPERATIVE SHOWING IMPROVEMENT WITH PATIENT WHISTLING. MARKED IMPROVEMENT IN ASYMMETRY OF ENTIRE FACE

For this reason the pedicle was made of sufficient length to reach the inner canthal region so that the necessary support might be obtained. The pedicle was delivered through the constructed tunnel and the distal ends sutured into the inner canthal region.

Through an intraoral incision along the anterior border of the masseter muscle, the anterior one-half of the muscle was pedunculated from its lower attachment at the lower border of the mandible. This pedicle was at least one-third larger than that used in the first case. Although we were pleased with the former results, it was felt that they might be improved by using a larger flap of muscle. Accordingly, the anterior one-half of the masseter muscle was used to form the pedicle. The distal end was split and the muscle flap threaded through a constructed tunnel under the buccal mucosa through the body of the orbicularis oris muscle at the angle of the mouth. One half was continued on through the body of the orbicularis muscle to a point near the midline and sutured in place. The other half was placed similarly in the orbicularis oris of the upper lip. To help accentuate the nasolabial fold the muscle flap was sutured to the outer border of the orbicularis oris muscle where it joins the risorius. A light pressure bandage was applied to the left half of the face.

MOTION PICTURES AS A TEACHING AID IN PLASTIC SURGERY

GEORGE V. WEBSTER, M.D.[1]

Pasadena, California

AND

RICHARD B. LEWIS, M.A.[2]

Universal City, California

Plastic surgery is particularly suited to demonstration by photographic means. Motion pictures, as teaching aids in plastic surgery, are therefore both logical and desirable. But all too often in the past, a so-called teaching film has been a mere photographic record of an operation, photographed from one camera angle, at a fixed distance from the operative fields, and frequently filled with boring details, such as endless suturing. Even more important, the main purpose of the film as a teaching instrument has been lost in the multitude of details shown, many of which are not strictly applicable to the ultimate use of the film. Although such reports have been agreeably accepted by medical audiences because of the novelty of seeing operations reproduced on the screen, they have failed to instruct either the neophyte or the specialist.

In an attempt to create effective teaching films about plastic surgery, two major objectives have been sought. One of these has been the recording of procedures for purely historical value. A reference library of films of this type is worthwhile, particularly in the field of military surgery in which special problems occur in great numbers during a war which are rarely encountered in civilian practice. Films provide a splendid pictorial record of the care and treatment of massive gunshot wounds of the jaws, to cite only one example. This type of lesion, except for an occasional accident with firearms, seldom occurs in peacetime, yet during a war a single ward may contain as many as twenty or thirty such cases. Methods may change, but the fundamental surgical experience thus recorded is priceless to a future generation.

The second objective which has been sought is the development of motion pictures which can broaden and supplement instructional methods now in use in teaching hospitals and medical classrooms. The motion picture can offer unique advantages to students or resident staff members who are learning plastic surgery. In the first place, with a library of adequate films on file in the teaching institution, illustrative case material is always available; a film can be projected, discussed, and re-projected until specific points of principle or technique are thoroughly understood. Details of the operative field are magnified on the screen, and often are exhibited with greater clarity than they are at the operating table where vision is restricted, in most instances, to the surgeon and his im-

[1] Formerly Technical Adviser on Plastic Surgical Motion Pictures for Bureau of Medicine and Surgery, Navy Department, Washington, D. C., Commander (MC) USNR.
[2] Formerly Assistant Head of Training Film and Motion Picture Branch, Bureau of Aeronautics, Navy Department, Washington, D. C., Lt. Cmdr. A-V(S) USNR.

not, the patient had a satisfactory correction of the facial paralysis since the second month following operation.

REFERENCES

1. Ballance, C. A., and Duel, A. B.: The operative treatment of facial palsy. Arch. Otolaryng., 16: 1, 1932.
2. Blair, V. P.: The delayed transfer of long pedicle flaps in plastic surgery. Surg., Gynec. & Obst., 33: 261, 1921.
3. Brown, J. B.: Am. J. Orthod., 26: 80–87 (January) 1940.
4. Brunner, Hans: Uber Plastische Operationer Facialist ahmung. Archiv. Klinishche Chirurgie, pp. 85–100.
5. Jianu, A.: Die Chirurgische Behandlung der Facialislaehmung. Deutsche Ztschr. F. Chir., 102: 377, 1909.
6. Eden, Rudolf: Ueber die Chirurgische Behandlung der peripheren Facialislohmung. Beitruge Zur Kliniscben Chirurgie, 1911.
7. Halle, M.: The occurrence of facial paralysis and methods for its correction. Laryngoscope, 48: 225, 1938.
8. Alexander, R. J.: Rocky Mt. Med. Jour., 38: 713–716 (Sept.) 1941.

to contribute to the desirable learning of the audience as specified by the outline; all other material should be considered extraneous, no matter how much it interests the surgeon and the producer.

As far as is practical, each stage of the treatment of the case which is important to the purpose of the film should be put down in a list. And, as far as possible, the individual sequences to be photographed should be described in detail. Such a listing of scene descriptions has been called an action outline, and will save much time and effort during actual photography. With these scenes in mind, both the surgeon and the photographer are prepared for the significant moments when the camera must be recording the case.

Actual photography of a case should vary from the previously prepared outline only according to the pathology encountered at the operating table, which cannot be predicted with accuracy in many cases.

THE FILM MEDIUM AND TREATMENT

For the general field of educational films, 16 mm. film has been standardized, and 16 mm. projectors are available in almost every first-rate teaching institution. There should therefore be no question as to size of film to be used for production and distribution of teaching films.

Although black and white films of good teaching quality have been made in the past, the advantages of color in the presentation of surgical operations are so great that if a picture is worth making at all, it is worth making in color. Exquisite details of plastic surgical operations are especially instructive when shown in full color. The circulatory changes in a pedicle flap, the color of a thick-split graft at the first dressing, the color of tissues in operations about the face and hands are but a few of the points which can be nicely shown. Improvements in color printing and processing during World War II will result in future medical films of a consistently high standard of color quality.

If it is at all possible, the film should be planned to include a sound track narration instead of silent titles. Good pictures can be made with silent titles, but the amount of interpretative information which can be given is limited, and the titles interrupt the flow of visual continuity. Synchronized sound permits the descriptive narrative to reach the ear of the observer at the same time that the visual material is presented on the screen. Although the picture on the screen carries the burden of instruction and illustration, the narration, if carefully written, can emphasize, clarify and interpret the significant action shown. Words need not be used to describe the obvious, often an apparent weakness in films, but audience attention can be guided through skillful narration.

When sound is used, a skilled script-writer should work with the surgeon, rewriting his descriptive account for use on the screen. These writers are adept at shifting phrases and re-framing sentences in accordance with the development of the pictorial presentation, and can turn a surgeon's medical description into a script which has qualities appropriate to motion picture technique and to the defined purpose of the film, yet loses neither any of the original meaning, nor deviates from scientific terminology.

mediate assistants. Then too, from the film library, a long-range follow-up result of a plastic procedure can be compared with an accurate pre-operative view, all within the course of a few minutes on the screen, whereas several years would be necessary to accomplish this in real life. Thus a motion picture library in the hospital is desirable so that a large number of cases can be accumulated in their completed form and be made available for detailed study at the appropriate point of training.

BASIS OF GOOD PICTURES

The preparation of a motion picture that is to be of genuine service as an aid to training is a complex skill, almost as intricate as surgery itself, and the specialist who plans and produces teaching films must have judgment and experience in his field commensurate with that of the surgeon in his. Professional results are always dependent upon professional competency.

To assure that a motion picture will serve the processes of teaching and learning, the foremost requirement is adequate advance planning. An orderly and objective procedure for planning is primary insurance that the effort and cost of film production will be justified by the finished product. Photography of medical subjects is in itself a specialized skill and also requires orderly and expert procedure.

PLANNING THE FILM

Before any actual photography is considered, the producer and the surgeon should hold as many conferences as necessary to outline the entire production. One method of film planning that has proved to be effective is the following, used in Navy film production. The first step in planning procedure, following the selection of the general subject to be photographed, is the preparation of a production outline. This outline includes specific and detailed written statements as answers to questions such as these:

1. To what audience is the film directed? What is the previous training and experience of the audience in relation to the proposed film?
2. What specific principles should the audience remember after seeing the film?
3. What specific skills should the audience understand after seeing the film?
4. What specific attitudes should the audience learn from the film?

Only after answers to these and other relevant questions are stated can the content and treatment of the film itself be determined. A word of caution may be useful: "One of the great weaknesses of many films is the inclusion of too much detail and the presentation of too many points to be remembered by the audience."

Constant reference by the surgeon and the producer to the stated purpose of the film as given in the production outline is an important element in preparing a clear and useful teaching film, both for the purpose of excluding extraneous detail and that of assuring the inclusion of that which is fundamental to the lesson in point. Each pictorial representation on the screen should be planned

various optical effects such as fade-in, fade-out, and dissolves, which are often done in the camera itself. The use of such effects and all such technical details should be left to the producers of the picture, but the surgeon should be familiar in a general way with their employment so that he can more intelligently cooperate with the camera crew.

One of the important reasons for careful pre-planning of film production is to permit the director and cameraman to determine, in advance, camera and light set-ups, optical effects, and other production problems determined by the operation to be photographed. Such planning simplifies photography and permits a minimum of lost time and inconvenience during surgery. Economies in production are effected, for example, by advance planning of dissolves from one stage of a sequence to another. Thus, the camera may show the beginning of a suture line, giving perhaps a detailed close-up view to show exactly how the suture is placed and what layers of tissue are being approximated to each other. The scene then "dissolves" into the finished suture line. Advance planning for such film treatment details eliminates actions unnecessary and unimportant to the purpose of the film.

To relieve monotony and to give the best view of the operative field, both camera angle and camera distance should be varied, giving views from a distance to orient the audience to the part of the patient being shown, moving to medium close-ups as the field is draped and finally close-ups of the operative field, with extreme close-ups where necessary to show important detail. If prolonged close-up views are interrupted by occasional views from new perspectives according to the surgery being performed, the effect on the observer is one of added interest, and, just as important, orientation of the audience to the subject is maintained. A good cameraman, of course, knows all of these details of film making and many more that have not been mentioned, but this brief outline has been given to aid the surgeon's understanding of the technical aspects of the photographic processes which affect his surgical routines.

SURGICAL TECHNIQUE

Operating before the moving picture camera is different in many ways from the surgeon's set routine. To obtain good pictures, the surgeon accommodates himself to the necessary changes. In the first place, for a particular operation, his operating time will necessarily be prolonged. The surgeon should plan for this and avoid crowding his schedule with so many cases that he feels hurried and cannot give his fullest coöperation to the cameraman. The patient's safety is obviously foremost in importance, and although a small amount of additional operating time is usually entirely harmless, there should be no thought of prolonging the procedure if the welfare of the patient is thereby in any way jeopardized.

Although new types of cool light sources for photography may ultimately become available, at present the problem of heat from the photographer's lights is of great concern in plastic surgery. One has only to feel the heat on his hand

The voice used for recording of the sound track should be that of a professional film narrator. No surgeon, unless he has had special training in speech, and in the very specialized business of recording for the screen, should attempt to record his own words for the sound track. The results of such amateur attempts are so poor that the surgeon himself would admit they should be done over by the professional.

The use of sound incurs additional expense, but in planning the budget for a picture, every effort should be made to provide for sound.

In surgical motion pictures, an increasing use has been found for animation. At the time of basic planning of a film, careful consideration should be given to the contribution that animation can make to the finished picture. Animation can often provide clear and dramatic exposition of the ideological background of surgical procedures. It can be used to illustrate principles, to impersonalize and simplify points of surgical technique, stages in operative treatment and to emphasize the teaching points within the film. In other words, to present ideas which cannot be clearly visualized and photographed in real life, animation is an extremely useful device in medical films.

The cost of animation is comparatively high, and for this reason a technique called "pseudo-animation" is sometimes used, which involves very few drawings to illustrate a sequence. This is done by photographing drawings of several completed stages of the operation and after pausing for study of one stage on the screen, dissolving to the next step, and so one. This technique has definite value and represents a great saving of time and labor.

Another important consideration at the time of initial planning is the ultimate use of the film. If a really worthwhile picture is planned and produced, its permanent usefulness should be safeguarded by provision for the printing and distribution of a sufficient number of prints. Each of these copies is made from the original film, which is screened ONLY ONCE, and then under carefully controlled projection conditions, so that everyone concerned with the production can see it and judge its technical and photographic quality. It is then duplicated and the original is placed in a film vault with temperature and humidity controlled to keep it in perfect condition. All rescreening of the subject, editing and cutting are then done with the duplicate work print. Only at the final stage of production is the original taken from the film vault, and the cutter, taking many precautions to protect the film, matches the original with the finished work print and makes necessary cuts and splices.

From this perfect original, all prints are then made for distribution of the finished picture. Or, if a large number of prints is contemplated, prints are made from master duplicates of the original. If the original has been damaged, every copy will show the defects of the original film; hence the great importance of protecting the original.

TECHNIQUE OF PHOTOGRAPHY

When actual shooting of the picture begins, the cameraman has a choice of a variety of shooting angles, lighting, and other aspects of presentation, as well as

REFERENCES

ARTICLES

1. Report of the conference on "Motion Pictures in Medicine" (Held in connection with the Annual Session of A M A on June 10th, 1942 in Atlantic City) American Film Center, 18 pp . mimeo
2 Morgan, J A . The department of visual medical education Quart Bull., Northwestern Univ. Med School, 18: 1, 55–62, 1944
3. Nichtenhauser, A Planned health film production J Health and Phys Ed , 251–253 (May) 1944.
4. Barr, J S · Medical audiovisual education in the U S Navy J A M A , 360–363 (June 3) 1944
5 Waters, L : Visual education in medicine J Assn Am Med Coll , p 177, Vol 19, No 3 (May) 1944.
6 Smiley, D. F.· An American Medical Association film service J A M A., 972–3 (July 28) 1945
7. Medical motion picture films (Expanded program of medical motion picture films authorized by Board of Regents) Bull Am Coll Surg , 30: 4, 437 (December) 1945

MOTION PICTURES

8 Catalogue of medical motion pictures on face and plastic surgery Bull Am Coll. Surg , 30: 4, 449 and 459 (December) 1945
9 Webster, G V.. Plastic operations on the hand 400 feet Color and sound 16 mm U S Navy Mn 6128a
10. Webster, G. V Plastic and reconstruction surgery of the hand 1200 feet Color and sound 16 mm U S. Navy Mn-6128b
11. Webster, G V. War wounds of the lips and cheeks 600 feet Color and sound 16 mm U. S Navy Mn-6485
12 Webster, G. V. Early care of plastic surgical cases I Wounds of the hand 400 feet. Color and sound 16 mm U S Navy Mn-2715a
13 Webster, G V.· Early care of plastic surgical cases II Wounds of the face and jaws 800 feet Color and sound 16 mm U S Navy Mn-2715b
14. Webster, G. V.· Plastic operations on the nose and ear 400 feet Color and sound. 16 mm. U. S Navy MPL-NNMC, Bethesda
15 Webster, G V · Use of pedicle flaps on the lower extremity 400 feet Color and sound 16 mm. U S Navy MPL-NNMC, Bethesda
16 Webster, G V.· Release of burn contractures about the face and eyelids 600 feet. Color and sound. 16 mm U S Navy MPL-NNMC, Bethesda

through the rubber glove to realize that this heat is too intense for a pedicle flap, particularly if the blood supply should be already somewhat impaired. It is safe to expose the tissues for a few minutes to these lights, but only long enough to complete a single shot. Here too, advance planning can minimize the time lights are required.

If maximum effectiveness is to be obtained from the motion picture production, both the surgeon and the cameraman should be familiar with the requirements of the script for production set-ups for each sequence. During the operation the surgeon must be able to forewarn the cameraman that an important step in the operation is to be made, and the cameraman can then prepare with a minimum of time and confusion. Then the surgeon must allow enough time for photography to be accomplished in the best possible way. This may involve moving lights and camera, with consequent rearrangement of the nurse's stands and trays. Lenses may have to be changed, and occasionally a new film inserted in the camera.

The surgeon can further aid the effectiveness of the film by following a few simple rules which have been found useful. First, he should wash the field with normal saline to clarify the structures to be shown, removing all blood stains and clots. Clean drapes should then be placed about the immediate field before each shot to avoid the distraction of bloody towels at the periphery of the visual field. He should wash his gloves and dry them on a sterile towel before each shot, for blood on gloves always detracts from the quality of a scene and wet gloves give too much light reflection.

The drapes should be dyed a light blue-green color, especially in color photography. This prevents the inevitable glare from white drapes and simplifies obtaining proper exposure. In addition, the color contrast of the green, which is complementary color of the red blood and tissues, greatly aids the clear presentation of the operation. Skin antiseptics which stain the skin pink should also be avoided for the same reason. Tincture of iodine or colorless mercurial antiseptics should preferably be used. Attention to such small details will greatly improve the quality of the finished motion picture, and the time and effort spent in attaining perfection in these matters is well rewarded by the excellent end-results to be obtained.

SUMMARY

Making a teaching film is an enterprise of considerable complexity and expense. To be worth the effort, every detail should be planned in advance. To be genuinely useful, films should provide students and practitioners with specific guidance and instruction, thereby warranting broad distribution.

Such films, undoubtedly, will be sponsored and financed by teaching institutions or by financial grants for this work. It is to be hoped that well-planned pictures of high technical quality will be produced for the advancement of teaching of plastic surgery.

A B C

Fig. 1. A Tumor of the Mandible in an Eight Year Old Girl.

At operation it was found that the entire thickness of the mandible was expanded and it seemed impossible to remove the tumor adequately and retain any bone at the tumor site. The periosteum was definitely involved on the buccal side but was free on the lingual. A resection was performed as shown in *B* and a double thickness of dental arch bar inserted as shown. A single strip of periosteum was retained. The neck incision was drained but was completely healed in ten days No other fixation was employed *C*. Regeneration present eight weeks following operation Union was solid to manipulation. No inflammatory reaction present. Repeated x-rays have been made to date, over twenty months time. No evidence of bone reaction is present, the bar is still in place and although the regenerated mandible is small in diameter, it seems adequate.

SUBPERIOSTEAL MANDIBULAR RESECTION WITH INTERNAL BAR FIXATION

LOUIS T. BYARS, M.D.

From the Department of Surgery, Division of Plastic Surgery, Washington University School of Medicine, St. Louis, Missouri

Resection of the mandible is often necessary to assure the control of certain tumors. This operation may be deforming and always poses the immediate problem of preservation of proper relationship of remaining fragments and eventual restoration of continuity of the bone. The solution is especially difficult when dealing with children or with adults when denied the aid of interdental wiring or splinting.

The operation of subperiosteal resection has often been used in various fields of surgery but little mention is made in the literature of this in relation to the mandible. It has frequently been observed that the mandible will regenerate with surprising adequacy after the sequestration of large segments following osteomyelitis. Similar regeneration has been found to occur following subperiosteal resection (figs. 1 and 3).

Obviously, subperiosteal resection is inadequate in the treatment of many tumors; it could rarely be safely performed for any of the malignancies. However, occasional situations arise where the entire thickness of the bone of the mandible must be removed but a few shreds of periosteum may be left bridging the gap between the ends of the bone. This can occur with adamantinomas, ossifying fibromas, osteomas, or even with more simple tumors which have expanded the bone to such an extent that the latter has largely been destroyed (figs. 1 and 2).

The technic of such an operation is that of any resection of the mandible. Usually the approach will be made through the neck rather than intra-oral.

It is important to preserve the infra-mandibular branch of the facial nerve. If the incision is made below the course of this nerve and the platysma and entire lower pole of the parotid reflected upward in the flap, avoiding any incision of the soft tissue between the lower pole of the parotid and submaxillary gland, the body, angle and a portion of the ramus of the mandible may be safely exposed.

Having exposed the tumor, its relationship to the periosteum is determined; if feasible, both lingual and buccal periosteum are preserved. Otherwise, such strands that are not invaded by tumor are left bridging the defect.

Regardless of the method of control of the fragments to be employed, the oral mucous membrane should be closed accurately and the fragments should be maintained in their proper relationship. In children regeneration of bone will occur with surprising rapidity.

INTERNAL BAR FIXATION

Splinting or interdental fixation in children is unsatisfactory. The same may be true in adults if the fragments are wholly or partially edentulous. In such

cases holes may be drilled in the ends of the bones and a bar of stainless steel snugly inserted to bridge the defect (figs. 1 and 3). Surprising rigidity results from this procedure and no other fixation is essential. If available, additional interdental fixation is desirable for a few days. In children the fragments have been brought into over-correction of about one-half the width of a central incisor tooth, and in one child observed over a period of twenty months and another for eleven months, good occlusion was maintained, the resected side keeping pace in growth during this period.

This fixation has been used in other types of resection and bone loss simply to provide temporary space retention and to restore rigidity of the mandible throughout the immediate post-operative period where respiratory difficulty might otherwise be expected. It is especially valuable in dealing with emergency conditions involving loss of the symphysis or operative removal of this area.

The stainless steel bar has been well tolerated by the tissues. In no instance has bone infection resulted, and in the cases of clean resection there has been no prolonged healing period. One case was observed where such fixation was employed in the treatment of an infected fracture with bone loss. The bar healed in place readily and the patient was not seen again for four years when he presented himself for removal of the bar because it was beginning to work through the alveolus. No infection was present.

In several cases an upper neck dissection has been performed in conjunction with cautery destruction of a primary carcinoma of the alveolar mucosa and secondary invasion of the mandible. If the cauterized mandible is left in place to sequestrate spontaneously, an oral fistula will result requiring subsequent closure. This cauterized bone may be resected, however, at the termination of the operation and replaced with the stainless steel bar. This produces much less inflammation than would the cauterized bone, provides adequate temporary rigidity of the mandible, and although the bar must eventually be removed, the oral fistula heals without secondary closure.

A B

FIG. 2. A photograph of patient shown in Figure 1 before operation, showing enlargement of right jaw. *B*. Five months after subperiosteal resection of the mandible. Microscopic diagnosis of tumor removed was "ossifying fibroma.

A B

FIG. 3. TUMOR OF MANDIBLE OCCURRING IN A NINE YEAR OLD BOY

History, gross, radiological and microscopic findings very similar to those described in Figure 1. *B*. X-ray taken seven weeks following subperiosteal resection and insertion of internal bar. It was possible to preserve more periosteum than in case 1 and regeneration has proceeded at a faster rate. In this case interdental fixation was maintained for 10 days and penicillin was given for one week post-operatively, at the end of which time the wound was healed. There has been no subsequent inflammation and at the end of eleven months the bar is still in place and the mandible strongly healed.

A B

Fig. 2. Illustrating the Extent of Development That Can Be Expected if the Philtrum Is Placed in Anatomical Position at the Primary Operation

A shows a bilateral cleft lip with a small contracted philtrum. B shows extensive development of the philtrum two years postoperative. Final adjustment of the vermilion to be completed after the palate repair.

Fig. 3. Uncomplicated Bilateral Cleft Lip. No Anterior Displacement of the Premaxilla. Lateral Sections of the Lip Can Be Readily Adjusted to the Philtrum

THE IMPORTANCE OF THE PREMAXILLA AND THE PHILTRUM IN BILATERAL CLEFT LIP

H. S. VAUGHAN

It has been stated, and with some justification, that no operation in surgery shows as uniformly poor an after result as follows the repair of bilateral cleft lip. To achieve a satisfactory repair it is necessary to conserve and adjust all available tissue to its correct anatomical position. Nearly all of the operations described in the older writings were based on the principle of adjusting the incised borders around a philtrum denuded of vermilion border (Rose, Brophy, Thompson, Berry and Legg, and many others). The procedures as described failed to fully utilize the central portion of the lip and produced, in most cases, a tight lip, greatly elongated from above downward, and short from side to side with the characteristic inverted vermilion border (fig. 1), although G. V. I. Brown, and Warren B. Davis, among others, long advocated retention of the lower vermilion border of the philtrum.

FIG. 1. ILLUSTRATING THE TYPICAL APPEARANCE FOLLOWING REMOVAL OF THE VERMILION FROM THE PHILTRUM IN BILATERAL CLEFT LIP REPAIR
Note the tight upper lip which is short from side to side

In general, it can be stated that very many specialists in this field have failed to realize the extent to which the philtrum will develop if placed in anatomical relation at the time of the primary repair (figs. 2A and 2B), a fact that has been frequently emphasized by Warren B. Davis.

For the past sixteen years, we have used the philtrum to form the perpendicular length of the central portion of the lip, reinforcing this border with excess vermilion from the alar sides of the clefts. Through further experience we have been able to follow a fairly standard procedure for these cases, and when later corrections and revisions are made, have not been confronted with a lack of usable tissues.

From the standpoint of surgical repair, bilateral cleft lip may be *uncomplicated* when there is no anterior displacement of the philtrum and premaxilla (fig. 3), and the lip can be readily repaired; also, when the premaxilla is slightly displaced

premaxilla are then thrust forward on the nasal tip with almost complete obliteration of the columellar labial angle (figs. 5A and 5B). In this type of displace-

FIG. 6. SHOWING LOSS OF PHILTRUM AND ADJACENT COLUMELLA FOLLOWING MISMANAGEMENT OF THE PREMAXILLA

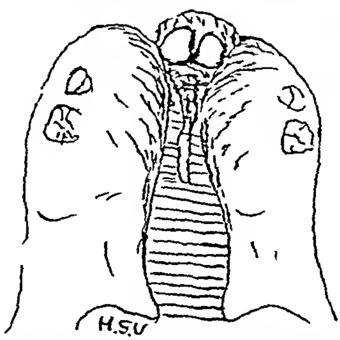


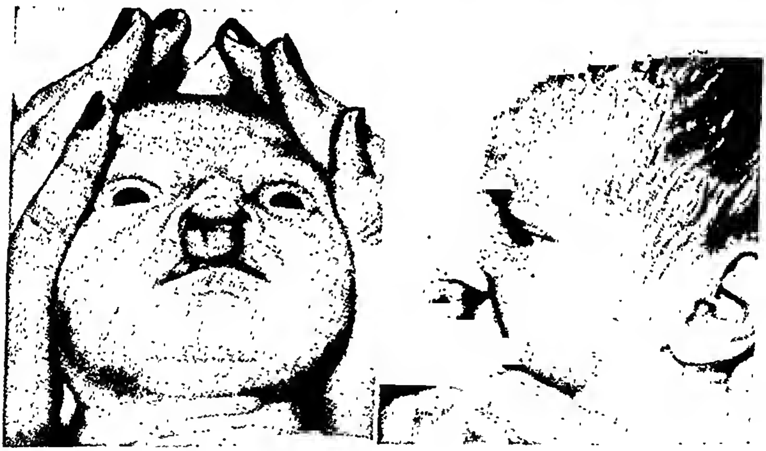
FIG. 7. DIAGRAMMATIC SKETCH FROM A PLASTER CAST SHOWING TRANSVERSE ROTATION AND LACK OF DEVELOPMENT IN THE PREMAXILLA FOLLOWING EXCISION OF A SECTION OF THE VOMER ANTERIORLY

ment the premaxilla has sometimes been completely resected, even including the philtrum (fig. 6).

The extreme displacement must be corrected surgically before the lip can be

A B

FIG. 4. UNCOMPLICATED BILATERAL CLEFT LIP
A shows some anterior displacement of the premaxilla. B shows the premaxilla pressed back sufficiently for lip repair without vomer incision.



A B

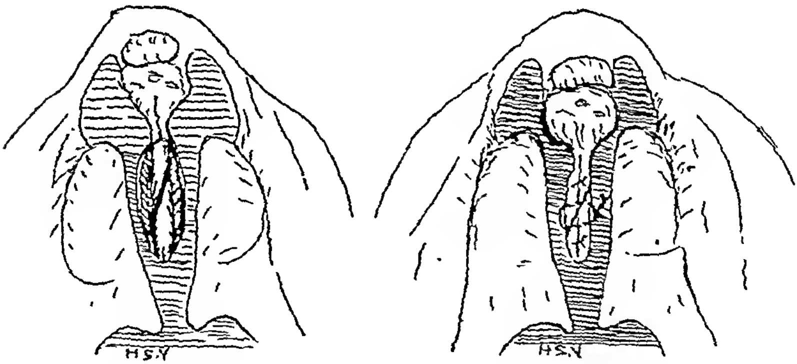
FIG. 5. COMPLICATED BILATERAL CLEFT LIP
A shows philtrum and premaxilla thrust forward with obliteration of the columellar labial angle. B same case as figure 5A, lateral view.

anteriorly, but can be pressed back and the lip repaired immediately (figs. 4A and 4B). Bilateral cleft lip may be considered *complicated* when the vomer and cartilaginous portion of the septum are over-developed. The philtrum and

A B

FIG. 10. SHOWING SAME CASE AS FIGURE 9 AFTER AN ABBE TRANSPLANT FROM THE LOWER LIP, ADVANCEMENT OF THE COLUMELLA, AND A PROSTHESIS FOR LIP SUPPORT TO REPLACE THE DISPLACED PREMAXILLA

A Shows full face. B Shows lateral view



A B

FIG. 11. SHOWING PROCEDURE WE PREFER FOR RETROPLACEMENT OF THE PREMAXILLA

A, diagrammatic sketch showing mucoperiosteum raised from each side of the vomer following an incision along the inferior border, posteriorly Also, shows the oblique chisel cut through the vomer. B shows the premaxilla pushed backward and held by a silver wire mattress suture. The mucoperiosteum has been approximated and sutured with fine silk. Note that the premaxilla is not quite in contact with the alveolar borders as when pushed into the interalveolar gap it is then too far back to adequately support the lip.

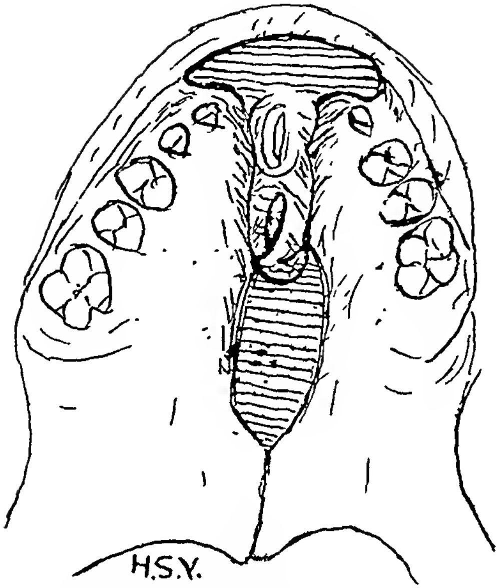


FIG. 8. DIAGRAMMATIC SKETCH FROM A PLASTER CAST SHOWING UNUSUAL DISPLACEMENT OF THE PREMAXILLA IN THE CASE SHOWN IN FIGURE 6

FIG. 9. SHOWING BILATERAL LIP DEFORMITY DUE TO LACK OF PREMAXILLARY SUPPORT
A shows full face. B shows lateral view

position like a pea in a pod, and is then difficult to stabilize (fig. 8). The lip is flat due to inadequate support. The deformity increases as the child develops, and the end result is a sunken upper lip, a prognathous mandible, an over-developed lower lip, and a dishfaced appearance (figs. 9A, 9B, 10A, 10B). Having tried all the suggested methods we prefer to correct the anterior displacement of the premaxilla in the following manner:

An incision is made along the lower border of the vomer posteriorly. The mucoperiosteum is elevated on both sides, and protected from injury by the insertion of a thin retractor on each side. An oblique cut is made through the vomer, using a very thin, broad chisel. The anterior end of the cut should be about 1.5 cms. posterior to the premaxilla (fig. 11A). The cut should extend upward through the vomer into the cartilaginous septum, and in this location the blood supply to the premaxilla is in no way disturbed. The premaxilla can now be moved posteriorly, and overlapped without rotation on its transverse axis, and without blocking the nasal passages. One or more silver wire sutures are used to retain the overlapped edges, and the mucosa is then closed with fine silk or dermal sutures (fig. 11B). Through this improvement in technique it is unnecessary in most cases to use silver wire through the maxilla, and around anterior to the premaxilla for support. When the premaxilla is pushed back far enough to fit in between, and contact the alveolar borders to form what appears to be a normal dental arch, it is then too far back to adequately support and hold the lip forward. It is far better to have a premaxilla too far forward than to have it fall back and fail to support the lip. We do not attempt to obtain union between the premaxilla and the alveolar border at this time, as much better flaps can be obtained when the anterior palate is repaired at two to three years of age, for the tissues are then thicker, better developed, and more favorable for final closure. The repaired lip continues to exert some backward pressure on the premaxilla. Replacement of the premaxilla is regarded as a preliminary stage. The lip operation is performed three or four days later.

In the repair of bilateral cleft lip the first consideration is to replace the separated sections to their correct anatomical relation with the minimum loss of tissue as shown in the diagrammatic sketches (figs. 12A, 12B, 12C, 12D). This may be regarded as the first stage. Minor adjustments may be made later, or when the palate is repaired. When the displaced sections of the lip are placed in anatomical relation the normal processes of growth and function tend to develop the tissues. Therefore, plenty of time, a year or more, should be allowed to elapse before adjustment or revision is undertaken.

SUMMARY

In practically all of the older operations for bilateral cleft lip, the alar sides of the cleft are adjusted around a philtrum denuded of its entire vermilion, resulting in an elongation from above downward, and a shortening from side to side. Far better results are obtained by using the philtrum for the central portion of the lip.

When the premaxilla shows extensive anterior displacement it must be re-

repaired. The correct position of the premaxilla is of utmost importance in providing support for the lip. The appearance of an otherwise satisfactory repair is greatly impaired when there is insufficient support from the premaxilla.

A method much used in the retroplacement of the premaxilla is to excise a V-shaped, or square section from the vomer just posterior to the premaxilla. The latter is then moved backward. Section of the vomer at this point has very

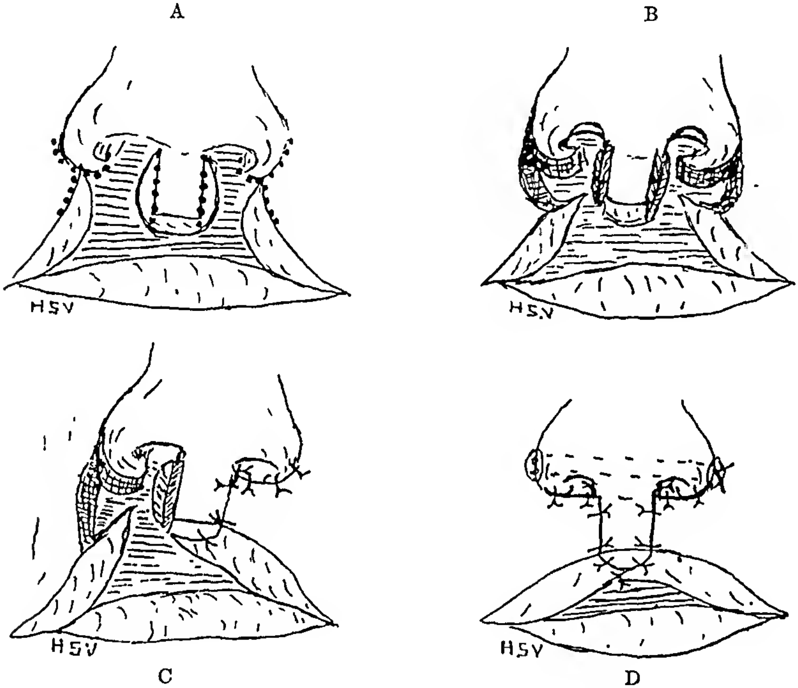


FIG. 12. DIAGRAMMATIC SKETCHES INDICATING THE PROCEDURE PREFERRED FOR THE REPAIR OF BILATERAL CLEFT LIP

A shows the incisions indicated by dotted lines. B shows the incisions opened before adjustment and suture. C shows the flaps adjusted and the sutures inserted on the left side. D shows the completed operation. Traction on the suture lines is relieved by adhesive plaster support and the Logan bow, or adhesive plaster on each side connected by a mattress suture.

serious objections. When excised in this location, and moved backward, the premaxilla rotates on its transverse axis, and the teeth when erupted are directed backward at an oblique angle (fig. 7). The nasopalatine vessels from which the premaxilla receives its blood supply pass through the area of excision, and are damaged. The premaxilla fails to grow and enlarge sufficiently to permit development of the incisor teeth, and even when the teeth erupt they are so far out of position, or at such an angle, that they are functionally useless. The premaxilla is also frequently separated from the septum, and rolls out of

THE REHABILITATION PROGRAM AND PLASTIC SURGERY

GUSTAVE AUFRICHT, M.D.

New York City

The indigent sick and physically handicapped, since time immemorial, have struck a sympathetic note in the complex structure of human emotions. Their need has been met, in differing degrees, by voluntary individual assistance and by the help of various charitable groups. These groups were formed by religious organizations, and by people of varying solidarity.

It gradually became evident that aiding the physically handicapped should not be the sole concern of the charitably inclined, individual citizen, for it is the responsibility of organized, civilized society. It is only within the past thirty-five years that the trend has been in the direction of actively attempting to rehabilitate such persons so that instead of being actual or potential burdens upon society, they might become totally or partially self-supporting members of the community. It is obvious that this would be advantageous both to the patient and to society.

Today, rehabilitating activities endeavor to restore the physically handicapped person to a partial or total self-supporting status, so that he may become a useful, self-respecting member of society instead of a dejected burden to himself, his family, and to the community.

Sparked by the efforts of voluntary organizations, public consciousness was aroused and governmental action made headway. It was recognized that the rehabilitation of the physically handicapped, involving as it does the utilization of various services, should be actively promoted and extended by governmental agencies. The discharge of many handicapped veterans following the conclusion of the First World War in 1918, led directly to the passage of the Rehabilitation Program of 1920 by the United States Congress. For the first time Federal funds were made available to be given as grants-in-aid to the several states for the purpose of the *vocational* rehabilitation of physically handicapped persons over the age of sixteen. At about the same time, several states passed laws enabling state programs of vocational rehabilitation to be inaugurated.

While the first Federal legislation was enacted in 1920, previous to that time many of the states had been engaged in various activities related to physically handicapped persons. For example, following the poliomyelitis outbreak in 1916, New York State inaugurated a program, administered by the State Department of Health, which was primarily concerned with orthopedic problems, establishing means for diagnosis and consultation throughout the State, and particularly in areas where such services could not be obtained, regardless of the economic status of the patients. During the 1920's, this program was extended through legislation whereby the *financing of treatment* for crippling conditions could be underwritten by public funds if the financial resources of the patients proved insufficient to defray the expense.

troplaced and held in position. Care must be exercised not to replace the premaxilla too far backward, as the lip must have ample support, and the repaired lip exerts some pressure.

The alveolar borders and premaxilla are not united until the palate cleft is repaired. Revision or adjustment of the vermilion border is deferred for one or two years.

REFERENCES

Berry, James, and Legg, T. Percy: Harelip and Cleft Palate. London, J. and A. Churchill, 1912.

Brophy, Truman W.: Cleft Lip and Palate. Philadelphia, P. Blakiston's Son and Company, 1923.

Brown, George van Ingen: The Surgery of Oral and Facial Diseases and Malformations, 4th ed. Philadelphia, Lea and Febiger, p. 549, 1938.

Davis, Warren B.: The Management of Bilateral Cleft Lip. Transactions of the American Society of Plastic and Reconstructive Surgery, New York, p. 99, Oct., 1943.

Rose operation, from Blair, V. P.: Surgery and Diseases of the Mouth and Jaws. St. Louis, C. V. Mosby, p. 201, 1914.

Thompson, James E.: An artistic and accurate method of repairing the defect in cases of harelip. Surg., Gynec., and Obst., 1912.

Veau, Victor: Operative treatment of complete double harelip. Ann. Surg., 76: 143 Philadelphia, J. B. Lippincott (Aug.) 1922.

rehabilitation service is under the supervision of the State Board of Vocational Education. The States are reimbursed by the Treasury of the United States.

In a sense, the activity of the Workmen's Compensation does a similar service as it provides for the medical and surgical rehabilitation of physically handicapped industrial casualties. This is entirely state supported, and has nothing to do with the afore-mentioned Federal legislation. In New York State it is a division of the Department of Labor, headed by an Industrial Commissioner.

Under New York law the employer must provide for an injured employee medical, surgical or other treatment, hospital care, etc. for the period recovery may require. All fees and other charges for such treatment and services are limited to a minimum medical fee schedule established by the Industrial Commissioner as recommended by the Medical Society of the State of New York.

Besides these main agencies, there are other organizations providing similar services. At times, not only the patient, but the physician is confused and bewildered by the numerous agencies capable of rendering rehabilitation service. However, the main point is that at this time both State and Federal legislation exists under which official state agencies are charged by law with the administration of programs for medical and surgical rehabilitation of physically handicapped persons, both minors and adults. The details of these programs vary from state to state. I understand that it is not the intention of any of the official agencies to provide direct services, but rather to purchase the best available services on a fee basis. Of course, if existing services are inadequate or lacking, it is the responsibility of the official agencies to promote the formation of such resources. In general, I have ascertained that only under the most stringent circumstances, would the official agencies consider the granting of direct services.

In all states in the Union the administration of the Vocational Rehabilitation Program is vested by law in the Department of Education. At times, it is difficult for us who are engaged in a busy office and hospital practice to realize that there are essential services related to medical care which cannot be performed by the individual physician and must be performed on a community-wide basis by some official agency. I have in mind such services as case finding; case follow-up to insure that the patient receives medical care over what may sometimes be a long period of time; and nursing service, whereby not only bedside nursing is provided but the family and patients are taught what to do in a particular case. Another service is the education of the lay public and of the general practitioner in order that they might recognize handicapping conditions at an earlier stage and thereby increase the effectiveness of medical treatment. Perhaps the most important of all is to refer patients receiving medical services to other proper agencies, both official and non-official, which may render essential social aid without which the medical treatment may prove partially or totally ineffective in the total rehabilitation of the patient in the community.

In order for you to form an idea of the extent of this program, I shall give you some figures obtained through the courtesy of Dr. Edward J. Rogers. To quote:

The agencies involved are the Division of Vocational Rehabilitation of the State Department of Education, which would in general handle patients over the age of twenty-one

Society's responsibility for the rehabilitation of physically handicapped younger persons, who were *not eligible* for the services provided by the Vocational Rehabilitation Law, was formally recognized by the passage of the Social Security Act of 1935 and its subsequent amendments. By this legislation, *Federal* funds as grants-in-aid were made available to the several states for the purpose of diagnosis and treatment of persons *under* twenty-one years of age, with crippling conditions or conditions which may lead to crippling. From Joseph J. Endres' comprehensive work, "The Education and Care of Physically Handicapped Children," I shall quote some highlights of special interest.

The *definition* of a physically handicapped child, according to the Education Law and the Children's Court Act, is one who by reason of a physical defect or deformity, whether congenital or acquired by accident, injury, or disease, is or may be expected to be totally or partially incapacitated for education or for remunerative occupation.

According to Endres, there are thousands of physically handicapped children in the State of New York who are in need of an adequate medical service, a good general education and vocational training to insure their economic independence. These children fall into three groups: first, the group of children whose parents are financially able to provide the special services needed; secondly, a considerable percentage of the entire group whose parents are unable to pay the entire cost of physical care and education, but who are willing to pay part of it; and thirdly, the group of children whose parents are unable to pay for any portion of the cost of preparing them for a useful future.

The laws were intended to provide as far as possible, the necessary services for the latter two groups of children. The judge of a Children's Court may order the necessary services for a physically handicapped child and make the entire cost of such services a charge against the county or the city within his jurisdiction. It is interesting to note that the judge may direct the parents of physically handicapped children to pay part of the expenses of the necessary medical or educational service. The Education law of the State provides, in turn, that the State will reimburse the county or the city for one-half of the cost of services

The judge of a Children's Court is authorized to issue orders for the physical care and education of physically handicapped children from birth to twenty-one years of age. The physical care which he may order includes medical or surgical service; hospital care; appliances and devices. (Endres)

The hospital standards are insured by the provision that institutions providing service must meet certain minimum requirements in order to obtain approval for state aid.

Vocational Rehabilitation legislation, first enacted in 1920 and amended in 1943, provides "Rehabilitation Service" for adults. The term "Vocational Rehabilitation" and the term "Rehabilitation Service" mean any service necessary to render a disabled individual fit to engage in a remunerative occupation. It is an act to provide for the promotion of vocational rehabilitation of persons disabled in industry or otherwise and their return to civil employment. This

Administrator of the Veterans' Administration, I obtained from Dr. Charles M. Griffith, Medical Director, the following information regarding the care of the plastic surgical cases:

> Plastic surgery is available at seven Veterans' Administration Facilities located at Bronx, New York; Washington, D. C.; Atlanta, Georgia; Hines, Illinois; Jefferson Barracks, Missouri; Los Angeles, California; and Portland, Oregon. Managers of the field stations of the Veterans' Administration, located throughout the United States, are authorized to submit clinical data and unretouched photographs of the part involved to the nearest of the aforementioned Facilities for determination of the need and feasibility of plastic surgery. Admission is arranged if need and feasibility are shown. The plastic surgery is performed by trained, full-time personnel of the Veterans' Administration, supplemented as indicated by civilian specialists or consultants on a part-time salary or fee basis.
>
> Provision of existing legislation and regulations do not permit a veteran to enlist the services of existing civilian facilities and specialists. However, by agreement with the Surgeons General of the War Department, Navy Department and United States Public Health Service, beds are made available for veterans in designated hospitals under their jurisdiction. In addition, contracts are negotiated with reputable civilian hospitals, depending upon need. Male beneficiaries, under existing legislation, may be hospitalized in civilian institutions only for emergency treatment of a disorder arising from a service-connected diability.
>
> Payment for hospital treatment in civilian institutions is made in accordance with the terms of the contract. Due to the variations in plastic surgery, depending upon the nature of the deformity and the number of operations involved, no set fees have been established.
>
> It is the policy of the Army and Navy Plastic Surgery Centers to retain patients in an active service status until maximum benefit has been attained. Accordingly, except in an isolated instance, a patient would not be transferred to the jurisdiction of the Veterans' Administration for plastic or reconstructive surgery. A central guiding and follow-up service has not been established for veterans upon discharge from active service. However, prior to discharge, all patients are informed by responsible officials of the services available through the Veterans' Administration.

This is a progressive and commendable program. We observe, however, that the veterans are not permitted to select their own civilian doctors. It would not be amiss, in this regard, to quote from the plan proposed by the Monmouth (New Jersey) County Medical Society, which was suggested for possible adoption by county units in the State of New York in cooperation with the Veterans' Administration.

> . . . All members of the (. . .) County Medical Society who are willing to serve will be designated as out-patient physicians on a fee basis for the Veterans' Administration. . . . The Society will supervise the work to make sure that the veterans are given proper care.
>
> . . . Plans are also being made to permit hospitalization of the veterans in local, general, or specialized hospitals.
>
> . . . The Monmouth County plan preserves the individual doctor-patient relationships and avoids the psychologically bad situation of being treated by a government doctor in whose selection the patient has no part. It will also obviate the hardship of traveling long distances to a veterans' clinical center.

There is another factor that might cause an awkward situation. While a veteran may have been treated in a service plastic surgery center by a specialist, who has since returned to civilian life, under the present plan the veteran might not be permitted to return to this same specialist who did the original work.

years, and the Bureau of Medical Rehabilitation of the State Department of Health which would mainly handle patients *under* twenty-one years of age. Our registers show approximately fifty to sixty thousand persons potentially under the care of the Bureau of Medical Rehabilitation because of physical defects. Of these, about half are located in New York City and would be under the direct jurisdiction of the Bureau of Physically Handicapped Children of the New York City Department of Health.

It is difficult to estimate how many cases might come under the services of the Division of Vocational Rehabilitation. During 1944 this agency had a case load of about twelve thousand. However, with the introduction of the *physical restoration* features in the Vocational Rehabilitation Program, this case load may increase very rapidly. During the past year some 3500 patients received surgical and/or hospital care, and/or appliances under the jurisdiction of the Division of Vocational Rehabilitation in as much as the physical restoration portion of the Program was not in effect in 1944.

The above figures cover only New York State and even there are not all the agencies which are dealing with physical rehabilitation are mentioned. According to Dr. Rogers' statement, "this case load may increase very rapidly." It is not far-fetched to believe that this program will assume great proportions in the not too distant future, and in all probability it will extend through every state in the Union.

With the event of the recently concluded World War II, we are concerned with, and interested in the program of the veterans' rehabilitation, as in that of the civilian rehabilitation. We are all aware of the fact that war injuries created a vast number of conditions in which the aid of plastic surgery is required. A superficial survey of the legislation for veterans convinced me of the fact that an active and broad program is being promoted for the rehabilitation of the injured in the armed forces. In this regard, I quote the following statement made by the Hon. John E. Rankin, (Chairman of the Committee on World War Veterans' Legislation):

> In considering the general scope of veterans' legislation, it is the general opinion of those persons experienced in the veterans' problems that the greatest benefit afforded to veterans by the Federal Government is that of hospitalization in a modern, scientific hospital where the highest type of medical care is afforded.

The extent of this program, and its growing tendency to meet the increased needs of the veterans after the Second World War are indicated by the following figures: In 1933 there were 71 hospitals and facilities; today, 94. In 1933, there were 71,846 beds available in the veterans facilities, Service and civilian hospitals; today there are 93,136 with new units and additions under construction and authorized which will provide 19,300 additional beds. The President has also approved the inclusion of funds for 14,000 additional beds in appropriation estimates for the fiscal year 1946. Completion of this program will result in a total of about 123,000 beds within the next several years, in comparison with the 71,846 in 1933.

The Veterans' Administration announced that a $6,000,000, 1000-bed hospital for medical and surgical cases will be erected at Fort Hamilton, Brooklyn, New York. Doubtless others will soon be added in other parts of the country.

As a result of personal communication with General Omar W. Bradley,

Administrator of the Veterans' Administration, I obtained from Dr. Charles M. Griffith, Medical Director, the following information regarding the care of the plastic surgical cases:

> Plastic surgery is available at seven Veterans' Administration Facilities located at Bronx, New York; Washington, D. C.; Atlanta, Georgia; Hines, Illinois; Jefferson Barracks, Missouri; Los Angeles, California; and Portland, Oregon. Managers of the field stations of the Veterans' Administration, located throughout the United States, are authorized to submit clinical data and unretouched photographs of the part involved to the nearest of the aforementioned Facilities for determination of the need and feasibility of plastic surgery. Admission is arranged if need and feasibility are shown. The plastic surgery is performed by trained, full-time personnel of the Veterans' Administration, supplemented as indicated by civilian specialists or consultants on a part-time salary or fee basis.
>
> Provision of existing legislation and regulations do not permit a veteran to enlist the services of existing civilian facilities and specialists. However, by agreement with the Surgeons General of the War Department, Navy Department and United States Public Health Service, beds are made available for veterans in designated hospitals under their jurisdiction. In addition, contracts are negotiated with reputable civilian hospitals, depending upon need. Male beneficiaries, under existing legislation, may be hospitalized in civilian institutions only for emergency treatment of a disorder arising from a service-connected diability.
>
> Payment for hospital treatment in civilian institutions is made in accordance with the terms of the contract. Due to the variations in plastic surgery, depending upon the nature of the deformity and the number of operations involved, no set fees have been established.
>
> It is the policy of the Army and Navy Plastic Surgery Centers to retain patients in an active service status until maximum benefit has been attained. Accordingly, except in an isolated instance, a patient would not be transferred to the jurisdiction of the Veterans' Administration for plastic or reconstructive surgery. A central guiding and follow-up service has not been established for veterans upon discharge from active service. However, prior to discharge, all patients are informed by responsible officials of the services available through the Veterans' Administration.

This is a progressive and commendable program. We observe, however, that the veterans are not permitted to select their own civilian doctors. It would not be amiss, in this regard, to quote from the plan proposed by the Monmouth (New Jersey) County Medical Society, which was suggested for possible adoption by county units in the State of New York in cooperation with the Veterans' Administration.

> . . . All members of the (. . .) County Medical Society who are willing to serve will be designated as out-patient physicians on a fee basis for the Veterans' Administration. . . . The Society will supervise the work to make sure that the veterans are given proper care.
>
> . . . Plans are also being made to permit hospitalization of the veterans in local, general, or specialized hospitals.
>
> . . . The Monmouth County plan preserves the individual doctor-patient relationships and avoids the psychologically bad situation of being treated by a government doctor in whose selection the patient has no part. It will also obviate the hardship of traveling long distances to a veterans' clinical center.

There is another factor that might cause an awkward situation. While a veteran may have been treated in a service plastic surgery center by a specialist, who has since returned to civilian life, under the present plan the veteran might not be permitted to return to this same specialist who did the original work.

Notwithstanding some inadequacies, we can agree with the statement of the Hon. John E. Rankin that "while there may be some inequalities yet to be straightened out, and some legislation we still hope to see enacted into law, the fact remains that taken for all in all, our system of caring for our disabled veterans has not an equal in any country in the world."

As plastic and reconstructive surgeons, our interest in these rehabilitation services, both civilian and veteran, is considerable. As a professional organization, we are concerned with the qualifications and the high standards of plastic surgeons, with increased teaching, and availability of knowledge regarding the conditions we handle.

I am certain that plastic surgery will be utilized in an increased amount by the rehabilitation services. It is therefore important that we cooperate to the fullest extent with these various rehabilitation services, in order that the best possible care be given to the physically handicapped and deformed patient.

ACKNOWLEDGMENT

In making this survey, I was greatly assisted, directly and indirectly, by authorities connected with the Rehabilitation program being carried out in the State of New York. Among them were: Dr. Oliver W. H. Mitchell, Chairman of the Council Committee on Public Health and Education of the Medical Society of the State of New York, and also Chairman of the Subcommittee on Rehabilitation; Dr. Edward S. Rogers, Assistant Commissioner of the Medical Administration of the State of New York Health Department; Dr. G. S. Bohlin, Director of the New York State Department of Education; Dr. Leon Sternfeld, Chief of the Bureau of Medical Rehabilitation, Department of Health, New York State; Dr. David Kalisky, Director of the Workmen's Compensation Board of the Medical Society of the State of New York; and Dr. Charles M. Griffith, Medical Director of the Veterans' Administration.

There is only a limited amount of literature available on the subject for the layman, most of it being legal accounts of legislative enactments and amendments. Dr. Joseph J. Endres, Chief of the Bureau of Physically Handicapped Children, New York State Department of Education has published "The Education and Care of Physically Handicapped Children," and the Hon. John E. Rankin (Chairman of the Committee on World War Veterans' Legislation) "Historical Statement of the Laws Enacted and Veterans' Regulations Promulgated Relating to Veterans and Their Dependents, With a Complete Statement Regarding Expenditures for Hospital and Domiciliary Construction."

PLASTIC SURGERY IN WORLD WAR I AND IN WORLD WAR II[1]

JOHN STAIGE DAVIS, M.D.

Baltimore, Md.

The American Association of Plastic Surgeons is the oldest society of plastic surgeons on this hemisphere, and as far as I can ascertain it was the first group of plastic surgeons to be organized anywhere in the world for the advancement of true plastic surgery and for mutual instruction.

As a subject of general interest to the Association, I will discuss plastic surgery in World War I and in World War II. The material for this talk is taken largely from a paper, which I read before the Southern Surgical Association last December, and which was published in the Annals of Surgery in April 1946.

In World War II, plastic surgery, as a general term, was used for the first time in our medical military terminology, instead of confining the subject to maxillofacial, or facial plastic and oral surgery, as had previously been done. This, on the surface, seems a minor matter, but the change was made only after the expenditure of much blood and sweat. The field of military plastic surgery extends from the top of the head to the soles of the feet, and its object is primarily the restoration of function and comfort, and incidentally the improvement of appearance.

When we entered World War I, there was total ignorance of plastic surgery in the medical corps of the armed services of the U. S., but it must be said, that even in civil hospitals and medical schools of that time, 1917, the appreciation of this branch of surgery as a special subject was also totally lacking.

The tables of organization in the army failed utterly to make adequate provision for plastic surgery in World War I, and repeated in World War II. Unquestionably, the first world war awakened general interest in the possibilities of plastic surgery, but few additions were made during this period, 1914–1918, to the basic prinicples of plastic surgery, which had been established long years before, although some of them were *re*discovered and reported as new. As a matter of fact, there have not been any important new principles in plastic surgery developed in World War II, but simply better and more skillful use has been made of methods and principles previously devised.

In England, when the unexpectedly great number of maxillofacial wounds began to come in, in 1914, there was no one trained to take over these cases, as their ignorance of the importance of the subject was, at that time, as profound as ours, when *we* entered the war. In this emergency, Harold H. Gillies, an otolaryngologist, was assigned to this work, although he had not had any previous experience in plastic surgery. He collected a group of men around him, including dental surgeons, and at first, by trial and error, the wounded men were treated. Later, as experience developed, the maxillofacial cases to which his service was

[1] Presidential address to the American Association of Plastic Surgeons, Toronto, Canada, June 3, 1946.

limited, were segregated, in a hospital at Sidcup because of the insistence of Sir Arbuthnot Lane, and splendid work was done. After our entry into World War I, a number of American medical officers, worked temporarily with Gillies at Sidcup, and obtained valuable additional experience. Full advantage was taken of the knowledge thus gained, and our own wounded requiring plastic reconstruction of the maxillofacial region, received, in consequence excellent care when they began to appear for treatment. Several U. S. Army centers were set up in France to which maxillofacial cases were supposed to be sent. One of these was Base Hospital 115 at Vichy, another was in Paris, and a third was in Bordeaux. My impression is that these centers were largely used in preparing cases for evacuation to the U. S., and that little or no definitive work was done in them. These patients were eventually sent either to General Hospital Number 11, at Cape May, N. J., or to General Hospital Number 2, at Fort McHenry, Baltimore, or to the Walter Reed Hospital in Washington, or to General Hospital Number 40 at St. Louis.

Marked progress was made in World War I in the treatment of fractures of the jaws, and in the repair of destructive wounds of the maxillae, by bone grafting and by adequate and ingenious prostheses, and these methods have stood the test of time and some have been improved upon in World War II.

There was also great opportunity to try autogenous cartilage transplants, and also iso-cartilage was used when the occasion presented and cartilage was available. Other tissues such as fascia, fat, periosteum, mucous membrane and nerves were also transplanted when needed. Some skin grafts and skin flaps were used, but very conservatively, particularly in regard to skin grafts, as compared with their lavish use in World War II.

In World War I, there were no definite regulations as to the treatment of burns, and each surgeon used his own judgement and individual methods. In World War II, on the other hand, a great deal of attention has been given to the treatment of burns, which have been very numerous. Much progress has been made, and burns are being better treated now than ever before, however, I do not believe that the final answer has yet been found. The main features in the most modern methods of treatment are the intelligent care of shock; the prevention of loss of fluids by non-adherent pressure dressings, infrequently changed; the prevention of infection, when the patient first comes for treatment and the prevention of secondary infection during dressings; the acceleration of healing by skin grafting as early as possible; and adequate nutritional care with proper vitamins, high protein diets, etc.

Artificial replacements of chins, noses, ears, eyes, etc., were devised in World War I, and are still being utilized both for permanent use and for the interval periods between operative procedures.

After World War I, scant interest was taken in plastic surgery by the regular medical corps of the armed services, and there were no surgeons in either of the services, who were especially trained for, or who showed any special ability to do this work. In fact, there was little official recognition of the scope and necessity of plastic surgery by the medical corps of either the army or the navy before we

entered World War II, as the tables of organization show. On the other hand since World War I, in civil practice, great advances have been made in almost every aspect of the art of plastic surgery, and a voluminous additional literature has appeared.

In World War II, a Subcommittee of the Division of Medical Sciences of the National Research Council on Plastic and Maxillofacial Surgery was appointed, and considerable study was given to the early care of wounds of the face and jaws by this committee, as it was realized from the experience gained in World War I, that skilled early treatment, within a few hours, if possible, after the wound was inflicted, made a great difference in the length of hospitalization and in the ultimate outcome. In order to facilitate early treatment, officers and men in the medical department in the combat zone were supplied with equipment for rendering first aid treatment for maxillofacial injuries and were instructed how to use this equipment; in arresting hemorrhage; providing adequate respiratory airway; securing temporary approximate reduction and fixation of bone fragments; and also to prepare the patient for safe transporation from the combat zone to hospitals in the rear, either in a sitting position or lying on a stretcher, face down, if there was any danger of obstruction in the air passages. Other points found to be important were—very conservative debridement of the face and hands; avoidance of packing facial wounds open; avoidance of removing any bone fragment with soft part attachment; insistence on the early closure of facial wounds by men trained to do this work; and the early covering of all extensive denudations by skin grafting or flap shifting.

The first idea about utilization of plastic surgery in World War II was that there should be a large number of plastic maxillofacial teams made up of a plastic surgeon and a dental surgeon, and that these teams should accompany troops to the front where they would give early plastic care to those requiring this service. A number of four and six weeks courses were given in different parts of the country to train men for this work. There was also one, three months course given by Jerome Webster and his colleagues at the Presbyterian Medical Center in New York City, which was excellent.

After a time, all of these courses were discontinued, as it was realized that most of the real plastic surgery, after early closure of face wounds at evacuation hospitals, should be done in the zone of the interior, and that a comparatively few trained general plastic surgeons in plastic centers, with adequate assistants and necessary equipment, could handle the situation much more satisfactorily.

No one in authority had an idea that plastic cases would be nearly as numerous as they have turned out to be in both services, and for *that* reason, the facilities at first provided turned out to be quite inadequate.

In time, nine centers in newly built Army General Hospitals, were designated for plastic work in the U. S.; the Valley Forge General Hospital being the first one assigned for this purpose on March 6, 1943, and the others were added as necessity arose. These are the Newton D. Baker; Wm. Beaumont; George W. Crile; H. D. Cushing; Dibble; Northington, O'Reilly and Wakeman, and when Northington was closed Percy Jones was made a center. The plastic patients

in these centers varied from 1000 to over 1700 on a single service, plus additional patients from the orthopedic and other surgical services. Many of these patients require multiple operations, and the operative schedule in some of the centers runs from 18–25 each day. Some of these operations are done under general anesthesia, some under local. All of them are based on the restoration of function, and none of them are of the purely cosmetic type. It is a thrilling and stimulating experience to see some of these centers in action and to observe the superb morale of the men, the team work of the surgeons and the remarkable results being obtained.

The skill, breadth of training, experience and understanding, and organizing ability of certain of the Chiefs of the Plastic Service is far greater than that of others, and in consequence, better planned and better executed plastic surgery is being done in some centers than in others. It was hoped that in due time, the work in all the plastic centers would become equally excellent. I felt that this could be accomplished by having general plastic surgeons in charge, and by having a thoroughly competent consultant in plastic surgery to supervise all centers. Then by the transfer of those unequal to the job and by adequate supervision and proper standardization of basic procedures the best results could be obtained.

The equipment, operating facilities, number of beds, number of assistants and nurses, etc., is better in some of these centers than in others, and several of them are badly overcrowded and understaffed. There has been considerable difficulty in supplying trained assistants at these centers as many men with plastic training were assigned to other work, and it has not been possible under the present organization of the Medical Corps, to get them back. Every facility is being used in some of the centers for graphically recording the wonderful series of plastic cases by moulonges, photographs, movies and drawings. In others, the equipment is poor and little interest is taken.

At the beginning of World War I, there were, with the exception of myself, no general plastic surgeons available in the U. S. In France, there was Morestin. In England, no one was trained along this line, but since then, the entire picture has changed, and there are now a number of excellent plastic surgeons in this country and in all other civilized countries. There are today very few class "A" medical schools where plastic surgery is not being taught or taught at, and in nearly all great hospitals, there are plastic services, but in the majority of instances without a complete residential service and with ridiculously few beds.

The American Board of Plastic Surgery has been organized, and there are two flourishing plastic surgery societies in operation, our own and the American Society of Plastic and Reconstructive Surgery. In consequence, when plastic surgeons were called for in this war many more trained men were available than there were in World War I

In World War I, for the first time, sections representing various special fields of medicine and surgery were established in the office of the Surgeon General in Washington, and among these sections were facial-plastic and oral surgery. Major V. P. Blair of St. Louis was called to the Surgeon General's office to or-

ganize this service. He was ably assisted by Major Robert H. Ivy of Philadelphia.

I urged at that time, that the Division be expanded to include all cases requiring plastic reconstruction regardless of the part of the body on which the lesion might be, but could not put it over, as there was no appreciation of the necessity of general plastic surgery by those with the power to act. I again urged this expansion in World War II, and some progress has been made along this line.

In World War II, in the Surgeon General's office in the Surgical Consultants Division, there have been created branches in general surgery; orthopedic surgery, neurosurgery, ophthalmology, otolaryngology, radiation, transfusion therapy and chemical warfare. It seemed strange to me, that a consultant in plastic surgery was not also added to the list. I, personally, felt that the lack of a representative in the field of plastic surgery in this war, considering the great number of casualties requiring plastic reconstruction was a mistake. In place of a consultant in uniform, several outstanding general plastic surgeons from civil life were appointed civilian consultants in plastic surgery during the last year of the war.

An inspection trip was made of all the U. S. Army plastic centers by two of these consultants, Dr. R. H. Ivy and Dr. J. P. Webster in April and May 1945, and a very comprehensive report was sent to the Surgeon General with certain well considered recommendations, but whether any of their recommendations were carried out is doubtful. No further use was made of any of the plastic consultants. I am delighted to be able to say that, although the war was over, Col. Barrett Brown was appointed consultant in plastic surgery in the Surgeon General's office in October 1945, so it was then possible to have all plastic centers under central observation and direction by an expert.

There are certain army general hospitals where there is, as there always should be, close cooperation between the plastic surgery section and every other surgical section in the hospital. In other hospitals, this cooperation is not evident, and in consequence, the most effective care of wounded men cannot be carried out. Every surgical division of the hospital, neurological, orthopedic, urological, ophthalmological and general at some time, needs the help of plastic surgery, and plastic surgery needs the help of every other division from time to time, therefore close cooperation is essential. Section or individual differences must be subordinated in order to give the wounded soldier or sailor the skilled care to which he is entitled.

The Dental Corps has an excellent organization, with active consultants, and is doing splendid work in its field. In most of the plastic centers, there is close cooperation between the plastic and dental services, and many of the problems of maxillofacial reconstruction are worked out together. The dental service is also invaluable in the construction of prostheses, plates, and various splints. However, it must be remembered, that dental surgeons, with few exceptions, are not qualified to perform plastic operations, even on jaws, on account of inadequate general surgical and plastic training.

Many orthopedic and neurological cases are referred to the plastic service for

the transplantation of soft parts to fill defects, before special operative procedures can be carried out, and some of the results are astonishing.

In a number of the army plastic centers following Dr. Sterling Bunnell's suggestion and wonderful demonstrations, hand cases requiring reconstruction have been grouped, and under plastic and orthopedic surgeons assigned especially to this phase of the work, very gratifying results are being obtained, and many hands have been salvaged, and made into useful functioning members, which seemed beyond saving.

In World War I, it was soon found that segregation of the maxillofacial cases in special hospitals or wards was most important psychologically in caring for these mutilated patients, and this should always be done, if possible, and is being done in our army and navy hospitals with plastic cases of all kinds.

At the beginning of World War I, there were no books available on the subject of plastic surgery, and although there were chapters in the surgical "Systems", nothing practical was available for the guidance of the military plastic surgeon. Since then, a number of books have been written on the subject and on its various phases. A recent contribution, written largely by Ferris Smith, is the Manual of Plastic and Maxillofacial Surgery, one of the military surgical manuals, gotten out by the Subcommittee on Plastic and Maxillofacial Surgery of the National Research Council. Another function of this committee, besides getting out the Manual, was to send recommendations to the Surgeon Generals in regard to improvements in the plastic and maxillofacial set-up in the army and navy. This was done at the early meetings on several occasions, with absolutely no results. However, things have improved.

In July 1946, the editors of a new journal, "Plastic and Reconstructive Surgery" will publish its first number. This journal will be the official organ of the American Society of Plastic and Reconstructive Surgery, and its pages will be open for papers, which are deemed worthy by the editorial committee. It is to be hoped that most of the articles on real plastic and reconstructive surgery will eventually be published in its columns. I have believed for a long time that such a journal is badly needed, and I am sure, that the editorial board will screen out much of the plastic surgery trash, that is now so freely published by many medical and surgical journals. I feel, that this journal, with its fine editorial board and excellent publisher will be a great success and should and will receive the full support of our own association.

One of the most important advances in the care of the wounded in World War II is the rapidity with which they are evacuated from the field to the hospitals where every care can be provided, and this is particularly important in the evacuation of severe burns and severe facial injuries. Sometimes, this can be done by plane in a few hours, and men are frequently back in the U. S. within a few days. There are also a number of army and navy hospital ships and trains to facilitate this evacuation.

The free use of plasma in this war has saved many lives, and the daily shipping of whole blood for use in those cases where plasma is insufficient was an added

factor of safety to the seriously wounded. All of these advances in treatment are as advantageous to men requiring plastic surgery as they are to other types of wounded.

Vast improvement has been made in the methods of anesthesia, both general and local, since World War I, and these advances have been most helpful in military plastic surgery.

The psychological handling of plastic patients requiring help along this line, is also being very well done in some hospitals and is a potent factor in securing satisfactory end results. In fact, the maintenance of high morale in the plastic wards means everything to each individual man, and also to all of the men as a group. Some of the surgeons know how to keep morale high, and in consequence, their general results are better and their wards are happier. The reconditioning program with its various activities also aids materially in helping many of the men back to a useful life.

In plastic surgery in this war, as always, asepsis should be aimed at, as often with scant tissue available for the reconstruction, infection may destroy the chance of the desired repair. But in battle wounds, infections frequently follow in spite of every precaution. In these instances, the wounded man today has a much better chance than he had in World War I, as with the local as well as the internal use of the sulfonamides and with the free use of penicillin and other substances, infections are prevented or controlled, and many cases which would previously have been fatal are saved.

In the European Theater in World War II, the Chief Surgeon, Major General Paul R. Hawley, promptly appointed a full set of consultants, including the specialties. It was foreseen early that a great number of war casualties would require plastic reconstruction, and their care could best be met by central direction. The first consultant was Lt. Col. J. Barrett Brown, and as his assistant Major Eugene M. Bricker.

It was difficult to establish plastic surgery as an army specialty, principally because of the lack of plastic surgeons on the tables of organization. However, great progress was made with the full support of the Chief Surgeon.

The first plastic center in E.T.O. was established in December 1942 at the 298th U. S. Army General Hospital, and on "D" Day, June 6, 1944, about 18 months later, there were ten functioning U. S. plastic centers in the United Kingdom where plastic, maxillofacial injuries and burns were treated. The purpose of these plastic centers was to treat early, and restore to duty promptly those with minor injuries and to evacuate to the U. S. as soon as possible, all those more seriously injured, who could not be returned to duty in from 120–180 days.

These centers were established within easy ambulance haul of the areas into which the patients were evacuated by air, water or hospital train, as it was important to get them into the hands of the plastic surgeons as soon as possible after injury.

On the continent as the invasion progressed, there were 11 or 12 plastic surgery centers in different hospital groups. Those of particular importance were at

Liege and Paris. The one at Liege functioned as a transit center for air evacuation of plastic patients to the U. S. Army centers in the United Kingdom. The two in Paris functioned for air evacuation of patients to the U. S.

In the Mediterranean Theater, no permanent plastic center was set up. Temporary designations were usually established in one of the general hospitals. The first one was in the 33rd General Hospital at Bizerte. During the Italian campaign, there was such a center, the 52nd Station Hospital, in Naples.

In the Pacific area similar arrangements existed toward the latter part of the war. In those areas throughout the world where special plastic facilities were not available, excellent work was done on plastic and maxillofacial cases by plastic and dental surgeons assigned to this work in different hospital installations as allowed by the tables of organization.

In England in World War II, Sir Harold Gillies, with his colleagues, has charge of all plastic surgery, and there are plastic centers at Basingstoke, Gloucester, Birmingham, Edinburgh and probably other places.

All British maxillofacial casualties in the African campaign were segregated in a center in Algiers, and in Italy a similar center was set up in Naples. Remarkably fine work was done on these patients, who were usually received within the first few hours after injury.

In South Africa, Major Jack Penn and his staff have done fine military plastic surgery at "Brenthurst" and later at the Witwatersrand University Hospital. Some of us have been fortunate in receiving "Brenthurst papers" edited by Major Penn.

Little authentic news about the progress and practice of military plastic surgery in World War II has come as yet from either the Russian Medical Corps, or from the military services of the Axis countries.

In World War II, as in World War I, there have been many more wounded men requiring plastic and reconstructive surgery in the army than in the navy.

In the U. S. Navy in World War I, there was no special service organized for the care of plastic cases. In World War II, the same procedure was followed at first, as it was said that the Surgeon General of the Navy did not see the necessity of a plastic section, and thought that any naval surgeon should be capable of doing plastic work. However, when a considerable number of men requiring real plastic reconstruction began to come in, this misconception was soon rectified, and with the help of a group of naval reserve medical officers, who were skilled plastic surgeons in civil life, several plastic centers were organized. In the center at San Diego, California, under Capt. H. L. D. Kirkham and his staff, who had been provided with fine equipment, large numbers of sailors and marines requring plastic work were splendidly cared for. There are several other naval plastic centers, where excellent work is also being done, one at the U. S. Naval Hospital at Bethesda, Md., another at St. Albans, L. I., another at the Oak Knoll Naval Hospital, Oakland, California, and another at Great Lakes. So the Bureau of Medicine and Surgery also waked up to the importance of having plastic work done by trained plastic surgeons. It is to be noted, that

there has been no special consultant in plastic surgery in the office of the Surgeon General of the Navy during World War II.

Now the war is over, what will be done with those men in the U. S. plastic centers on whom plastic reconstruction has not been completed, and also with those who will require operative treatment over a period of years?

In order to get information for the Association on this subject, on April 26, 1946, I wrote to the Surgeon General of the Army and also to the Surgeon General of the Navy, asking certain questions and telling them that the information furnished would be passed on to you at this meeting. I have received the following information from Major General Norman Kirk, the Surgeon General of the Army, dated, May 2, 1946, which will give an idea of what the army plans to do.

"1. Plastic centers are currently operating in the following general hospitals:
Cushing, Framingham, Mass.
Valley Forge, Phoenixville, Pa.
O'Reilly, Springfield, Mo. (closed Sept. or later)
Percy Jones, Battle Creek, Mich.
Wakeman, Camp Atturbury, Ind.
Beaumont, El Paso, Texas.
Crile, Cleveland, Ohio.
Newton D. Baker, Martinsburg, W. Va.
Dibble, Menlo Park, Calif.

2. The following hospitals are due to close approximately June 30. No more plastic cases are being admitted thereto. In the case of Beaumont General Hospital, it does not close but it is receiving no more plastic patients and will close as a plastic center.
Crile, Cleveland, Ohio.
Newton D. Baker, Martinsburg, W. Va.
Dibble, Menlo Park, Calif.
Beaumont, El Paso, Texas.
Wakeman, Camp Atturbury, Ind.

3. By the end of June 1946 it is anticipated that 3100 plastic cases will be remaining which require treatment. When Dibble closes, the plastic cases, along with the personnel necessary to do the job, will be transferred to Letterman as a group, thus opening a plastic center at Letterman. With the closing of Cushing and Valley Forge late in 1946 or early in 1947 a plastic center will probably be established at Walter Reed.

4. Early in 1947, the remaining plastic cases will be treated at Letterman, Walter Reed and Percy Jones.

This will be the plan—which is subject to change according to the work load. We are planning to separate those doctors who have been frozen and promoted as early as their services can be spared. The criteria for separation will be based on the number of points and length of time in service—if the individual's services are no longer needed."

Plastic cases in the permanent military hospitals will probably be taken care of by the young plastic surgeons, who have been trained in the plastic centers, as long as they can be retained in the army. There is also the possibility of training a few regular army surgeons to do this work, and then again some of the men now trained in plastic surgery may decide to remain permanently in the regular army. I understand that there may also be civilian plastic consultants at strategic points in the U. S.

In those plastic cases where treatment will have to be continued for several years, it is probable that these patients will be turned over to the Veterans Administration, if they are willing to be transferred, and if the Veterans Administration has facilities which are comparable with those in which the men are being treated in the permanent army plastic centers. But I understand that the army has no intention of even trying to transfer these patients until entirely adequate facilities, both physical and professional, have been assured.

The Surgeon General of the Navy, Vice-Admiral Ross McIntire writes as follows, dated May 22, 1946.

"The Navy has, at the present time, five plastic surgery centers in the Naval Hospitals in St. Albans, New York; Bethesda, Maryland; Great Lakes, Illinois; San Diego, California; and Oakland, California. There are approximately seven hundred patients in these five centers undergoing plastic procedures. Of course, there are a few plastic surgical cases in the other Naval Hospitals, but the majority are concentrated in the centers.

It is planned in the near future to disestablish any excess of these centers as the needs indicate. However, the Navy plans to retain permanently sufficient plastic surgery centers to meet the continuing requirements. The centers will be maintained in the most desirable geographic areas consistent with availability for patients and plastic surgery consultants."[1]

It is interesting to note how plastic surgery is handled in Canada. The Navy, Army, Air-force and Department of Veterans' Affairs have joined to provide specialty surgery of all varieties. As far as plastic surgery is concerned, these joint service special treatment centers are in Montreal, Toronto and Vancouver. The work of these units has been supervised by a Joint Service Advisory Committee to the directors of Medical Services of the Navy, Army, Air-force and the Department of Veterans Affairs. The joining of the active services with the Department of Veterans Affairs has worked out very well for specialty surgery. Now the war is over, the Department of Veterans Affairs is taking on skilled workers from the armed services, and the units will eventually no longer be combined service, but *completely* Veterans Affairs.

The efficacy of the Canadian system has been demonstrated to us by the splendid work in all plastic fields which we have had the privilege of seeing in Toronto.

To sum up in a few words, I can say without reservation, that the wounded service man in World War II, who requires plastic reconstruction, has been better cared for in almost every way than he could have been in World War I.

The superb results obtained in most of the armed service hospitals by the trained plastic surgeons and by the younger surgeons under their direction, have been among the outstanding triumphs in the surgical annals of World War II.

Those of you, who have participated actively in this work have every reason to be congratulated on a job well done, and those of us who have been civilian consultants and lookers on, are proud of you, and of what you have accomplished for the wounded men and for plastic surgery.

PLASTIC PROBLEMS IN THE HAND[1]

STERLING BUNNELL, M.D.

San Francisco

The purpose of this paper is to emphasize that there are certain features peculiar to the hand that call for special lines of thought and procedure in planning its plastic repair. In brief, but to be enlarged upon in turn below, there is the problem of nutrition, the source of supply being longitudinal and through the narrow wrist; the hand is a mobile organ not to be restricted by lines of scar; it is a tactile organ; it contains many important deep structures and it is prone to stiffen.

NUTRITION RESTORED BY LIBERATION FROM CICATRIX

Cicatrix is avascular fibrous infiltration that contracts binding all structures in its grasp both deep and superficial. Movable structures are bound, and lifelines, such as blood vessels, lymph vessels and nerves, are strangled. Such a cicatrix impoverishes the hand. It may infiltrate the whole hand or be along its only source of supply, the forearm or the narrow wrist. A cicatrix on only one side of a limb so draws to itself both deeply and about the surface that it acts as a veritable girdle. The two-thirds of circumference that is of good skin will be tight. As in repair of deep structures throughout the body, this cicatrix should first be excised and replaced by good pedicle skin. If operation is done through cicatrix, wounds will not heal, structures will not be movable, bones will not have sufficient blood supply to unite and the nutrition of a hand will not be improved. Repair should start with the excision of the cicatrix, the skin borders should be undermined from the deep fascia and allowed to retract. The defect is then filled with good pedicle skin. At the next operation for repair of the deep structures, the deep cicatrix is dissected out and excised en bloc, freeing the deep structures. The effect on the hand is liberation from binding cicatrix, so it breathes and thrives again and nutrition is restored improving its every structure. This viewpoint is to decry the mere removal and replacement by pedicle of a surface cicatrix with no regard to excising the deep cicatrix from between the deep structures or thoroughly freeing the skin borders.

If *flexion contracture* is present, and on stretching, the skin whitens, the skin is the primary cause of the contracture, the deep structures being contracted secondarily. If the skin does not whiten, deep tissue is primary and skin secondary. The size of the skin defect is ascertained by comparing measurements with the other hand with all its joints placed in the position opposite to that caused by the contracture. Comparative distances between various similar two points are taken longitudinally down the wrist, palm or fingers and transversely in various lines across the palm with the five digits fully spread, and across the dorsum with all

[1] Presented before the American Association of Plastic Surgeons, June 3, 1946, Toronto, Canada.

fully flexed. In estimating the size of our pedicle, one-third more is added to allow for the tightness of the skin about the contracture. Before a hand can be placed in the opposite deformity, the deep portion of the flexion contracture must be relieved whether fascia, tendon or joint capsule.

THE HAND IS A MOBILE ORGAN

The skin of the hand is so specialized that it covers throughout and without strain irrespective of the many positions this versatile and mobile organ may assume. Too frequently skin is applied to the hand merely as a surface patch replacing a cicatrix, unmindful of this problem. The borders of the patch, if they coincide with the directions of push and pull, are subject to the irritation of push and pull, and will form thick contracting keloid-like scars. Before making any incision in the hand, this priniciple should be considered. Incisions should parallel the wrinkles or flexion creases wherever possible and never cross them at or near a right angle. A median longitudinal incision anywhere in the hand is pernicious. This principle, so evident in hands, which are so mobile, applies to skin throughout the body.

On the dorsum of hands is fine cross-wrinkling to give length of skin from forearm to fingernails when we make a fist with the wrist in flexion. Special redundancy caps the knuckles for free movement. Our skin plastics must regard these features. An example of error is a pedicle graft placed as a circular patch on the dorsum of the hand so that the distal border parallels the thumb web and the proximal border forms a line across the back of the hand. The border along the web, due to the motion of push and pull, thickens to a keloid contracture, and the proximal border contracts so that the thumb cannot oppose and the metacarpal arch cannot curve. There is a transverse stretching of the dorsal skin as well as longitudinal. Infact, the total area of dorsal skin of hand and fingers is one-third greater on making a fist.

The volar aspect is cleft by deep folds. These take up the slack of the skin on making a fist. The total volar skin area on making a fist and flexing the wrist is very small compared with when spreading the hand and dorsiflexing the wrist. These folds are transverse in the fingers, thumb, palm and wrist, and in the palm are also oblique to accomodate closing and spreading between thumb and the last three fingers. If a surgeon bears the importance of these structures in mind, he cannot place an incision or a border of a pedicle or free skin graft directly across either the deep volar folds or the fine dorsal wrinkling. He must picture the hand as mobile and so arrange his scars to accommodate motion in any direction.

When supplying new skin to the hand the amount should be ample to cover, when the hand plus wrist are in complete flexion and also in complete extension and dorsiflexion, including any additional slack needed to allow, at the same time, full pronation and supination. Transversely, the palm should have sufficient skin to accomodate for the full spread and similarly the dorsum for opposition of the thumb and a fully curved metacarpal arch.

Whenever a scar or the border of either a pedicle or free graft may cross a

flexion crease at a right anlge, that is, coincide with the direction of push and pull, a zigzag or curved line should be made. A cross slit may be cut and a tongue of skin drawn into it, or the patch should be patterned with indentations and blunt points in accordance. Instead of a scar paralleling the web, a long tongue of the graft should be laid across the web. To fill a thumb cleft the pedicle graft across it should be long and diamond-shaped, the points or angles reaching to the juncture, or hinge, of the first two metacarpals both in front and in back. Longitudinal scars or graft borders about the wrist are bad in any part of its circumference as the wrist is a universal joint. In fingers the flexion creases extend back only to the midlateral line. Along this line a scar may become almost invisible, but let the scar be placed more volar or more dorsal to it and it will thicken and contract, because it will be subject to the irritation of push and pull. In applying free grafts to replace scars from burns along the dorsum of a finger, one should either zigzag the borders or furnish enough skin to allow the borders to follow the midlateral line of the finger on each side.

Pedicle grafts are often made excessively thick so they stand out in a grotesque dome, the idea being to furnish ample skin. This, however, except in few special cases such as clumped fingers, is a fallacy because skin itself will grow to cover at normal tension any area. It is the borders that are unyielding and contract instead of elongating. It is they,not the skin itself, that hampers motions. Pedicle skin should lie flat with the hand. Too much fat is parasitic, being an additional burden on the blood supply. It should be trimmed fairly thin with the skin just leaving enough to place a layer between the tendons if needed. The main blood supply, as seen on cross section, is between the fat and the skin so it is safe to trim away the redundancy. To correct excessive fat in a pedicle requires two operations.

THE PLASTIC OPERATOR SHOULD HAVE DUE REGARD TO THE DEEP STRUCTURES

Of the whole hand problem, the skin is only a part. If, when pedicle skin is placed, careful notes as to the condition of the deeper structures are not made, the later deep repair will be handicapped. All dissections of the hand should be done under the ischemia of a pneumatic tourniquet. This should spare the deep structures from injury, such as nerves, tendons, blood vessels, pulleys and joint capsules. Severance of the motor thenar nerve destroys opposition, and, of a volar digital nerve, sensation. Incisions that parallel tendons cause adhesions to the tendons their full length. Skin replacements should be planned so that, when later the deep structures are repaired, a flap may be turned back rather than placing the scar directly over the repair.

THE HAND IS A TACTILE ORGAN

In the hand sensation is equal in value to motion. The hand is a sense organ specialized for stereognosis. This is especially true of the area supplied by the median nerve. The pulps of the thumb and first three fingers are the eyes of the hand. Their rugae furnish separate points of contact for crisper images. The

pulps are rich in special touch corpuscles, the most sensitive spot in each being in the whorl of the fingerprint.

When we construct a new thumb or finger, using pedicle skin from theabdomen, or place a patch of this on the tactile surface of a digit, sensation to distinguish touch or pain will return, but not at all like the quality in normal finger skin that makes for stereognosis. Therefore, whenever possible, it is well in these strategic areas to, by transposing normal skin from the vicinity for pedicle skin, furnish this quality of sensation. The nerve attachments should wherever possible accompany the skin flap. When a finger is to be discarded, its volar skin may be utilized transferring it as a pedicle with blood vessels and nerves intact to the digit which is in need of tactile covering. In reconstructing a thumb, it is of great advantage to do it by transferring another digit with its blood vessels and nerves attached to be the new thumb, so that it will have normal sensation.

HANDS ARE PRONE TO STIFFEN

Too much and too prolonged splinting stiffens hands, especially if they are swollen. Another great cause of stiffening is an open wound. The products of this inflammation, even in the course of a few weeks, result in considerable stiffening. Therefore, wounds in hands should be closed early by primary or secondary closure or skin grafting. The application of this is in applying pedicle skin to a hand. I am convinced that for a hand we should never use the open pedicle method, that is, the septic pedicle. The open stem of a pedicle is equivalent to an open wound in the hand. The lymphatic vessels carry the products of inflammation directly into the hand, resulting in very undesirable stiffening. All pedicles to hands should be rendered aseptic by closure. This can be done by either tubing or skin grafting over all raw surfaces. Neat, careful suturing of pedicles makes for clean healing, instead of dirty borders. It is important, also, to prevent stiffening to avoid collections of serum or blood by careful hemostasis, placing drains for 24 hours, and avoiding dead space and edema by building about the pedicle a firm pressure dressing that fills in every interstice.

FURNISHING NEW COVERING

In supplying pedicle skin to the many thousands of injured hands in our Army hospitals, the direct abdominal flap in one stage, which is time saving, has been the method of choice, except where the tube pedicle was preferable. The latter was better adapted to fit into bizarre shaped areas especially involving various fingers and where, from lack of pronation and supination, the hand could not reach. Direct flaps, using a broad flaring base and a maximum length to breadth proportion of $2\frac{1}{2}$ to 1, were made in a vertical direction along the network of the thoracico-epigastric vessels. They were turned up or down as best fitted. The arm was strapped to the abdomen, moving with the abdominal skin. The under surfaces of the pedicles were rendered aseptic by skin grafting them and the donor areas were closed by sliding or skin grafting. Occasionally, the skin of the pedicle was tubed in the one stage.

Stemless flap grafts, according to a method of Blocker, were made by outlining

the pattern on both donor and recipient areas. Half of the pattern on the abdomen was freed and turned over on the abdomen. The two raw areas then presenting, corresponding in size to the original pattern, were sewed together about about their peripheries. It was found that the separation should be done in two stages as the area attached to the hand could not support an equal area of flap. In using a tube pedicle when it is difficult to hold the hand correctly, exact position must be maintained by fixation in plaster of Paris as in cross leg flaps. A tube pedicle is useful in conveying a pancake-like expansion of skin cut to pattern, but this must be prepared in several stages. When one digit is to be discarded, it often may be filleted and its skin, together with nerves and vessels, made to replace cicatrix in either the palm or dorsum of the hand, or on another digit. When all digits and part of the hand are to be covered at once, it is found that if the mitten method is used, that is, first sewing all fingers together as a mitten and applying the pedicle, the pedicle skin which may have been ample at first shrinks so it is difficult to have enough to cover all fingers. Therefore, it is better to prepare either a direct flap or a flap on the end of a tube pedicle, interdigitating it in several stages, to be applied at once to all the fingers. On detaching from the abdomen the base of the pedicle is then laid down on the hand.

Primary closure of civil wounds when possible is advisable. It is time saving, keeps hands limber and covers over vulnerable structures that might otherwise give a long siege of infection and sloughing. Closure may be accomplished by sliding skin flaps from the dorsum of the hand and skin grafting the denuded areas so left. Formerly it was dangerous to apply primarily an abdominal skin pedicle as the fat there was too vulnerable to infection. Now, however, with chemotherapy, it may be done and with great advantage of early closure and in keeping hands limber.

BURN PROBLEMS

For all but deep burns resurfacing may be done under chemotherapy at the time of granulations or later after a temporary thin skin graft had been used. A thin graft is a surer take on granulations, but a thick graft makes better skin. Fortunately, burns have a good vascular base as the damage was done from the outside in. Therefore, free grafts will usually suffice. Even a small clot of blood will spoil the perfection of a skin graft so it is best to retain the tourniquet until the pressure dressing is in place. After dorsal skin grafts exercise should be started early to prevent stiffening. Tendons, joints or bones when burned, need later recovering by pedicle skin. It is frequent after dorsal burns to see tightly flexed middle finger joints and hyperextending distal ones, because extensor tendon for the middle joint has been destroyed. It is rare to successfully supply a new tendon for this and then only after the finger has been covered by pedicle skin and the joint is in good condition. It is usually best to force the joint, or osteotomize it, to a position of semiflexion and there to pin it until arthrodesed. The hyperextended distal joint may be similarly treated. Deformed nails and matrices may be substituted for by free skin grafts.

PREHENSION IN A HAND

An important function in a hand is the ability to oppose one digit to the other to pick up or hold objects and this can be furnished in several ways. If all digits have been amputated, the metacarpals may be phalangized for depth of clefts, excising the second and fourth for width of clefts. After loss of some digits, the remaining ones may be made to oppose each other by angulatory rotary osteotomy through the bases of their metacarpals. Additional strength should be given these digits by transferring to their tendons those of the unused muscles in the forearm.

For loss of a thumb, a new one may be furnished by transferring the index finger, or what is left of it, into its place, in which case sensation and motion are an advantage, or may be reconstructed by tube pedicle and bone graft. If part of the metacarpal is present, the thumb will have motion. If the thumb is to be an immobile post, it should be short and thick. New thumbs should be made, not at the side, but in the path of the fingers, and before they are used should be kept protected by a thumb stall until they acquire sensation to pin prick. Otherwise, a trophic ulcer may form and destroy the bone graft.

FURTHER USES OF THE SICKLE FLAP IN PLASTIC SURGERY[1]

GORDON B. NEW, M.D.,
Section on Laryngology, Oral and Plastic Surgery, Mayo Clinic, Rochester, Minnesota

When the sickle flap was first employed, it was used for the correction of postoperative defects of the nose secondary to the removal of postirradiated cancer with surgical diathermy. In the sickle flap, I used the skin that is of the same texture and color as the lost portion of the nose, creating very little noticeable

Fig. 1a. Site of basal cell epithelioma after it had been removed by surgical diathermy. b. One year after reconstruction by use of a lined sickle flap.

defect at the donor site. Since the sickle flap was first employed, its usefulness has extended so that now it may be utilized to reconstruct almost any defect of the face where a pedicle flap is needed. It has been found, however, that in reconstructing the tip of the nose or in total rhinoplasty, the lateral attachment of the flap tends to pull the nose off toward one side; therefore in place of the lateral sickle flap, we now use a midline sickle flap so that there is no lateral displacement and the end result is much better. The following cases illustrate the added use of the sickle flap in plastic surgery.

Case 1 illustrates the original use of the sickle flap in reconstructing half of the nose in which it was possible to excise the remaining skin graft on the forehead so that there was

[1] Read before the meeting of the American Association of Plastic Surgeons, Toronto, Ontario, Canada, June 3, 1946.

very little evidence at the donor site. The patient, thirty-one years of age, had a postirradiated cancer of the nose of seven years' duration. Figure 1*a* shows the site of the lesion after it had been removed by surgical diathermy. Microscopically it was a basal cell epithelioma that had infiltrated beyond its apparent margin. Figure 1*b* was taken about one year later. The right half of the nose was reconstructed using a lined sickle flap. There

FIG. 2*a*. Original lesion. *b*. After removal of lesion by surgical diathermy. *c*. After reconstruction.

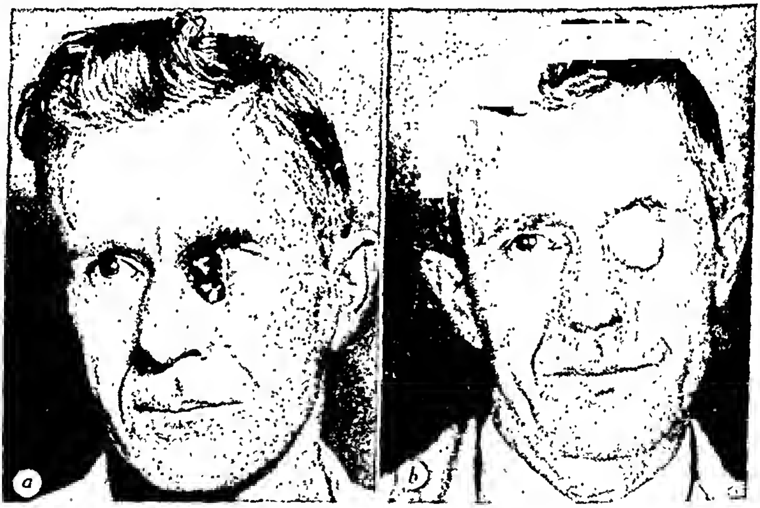


FIG. 3*a*. Postoperative defect. *b*. Closure of the defect by means of a lined sickle flap

has been no recurrence of the epithelioma. The patient has a good cosmetic result three years later.

Case 2 illustrates a postirradiated epithelioma that involved the cheek as well as the nose. The patient, forty-three years of age, had a basal cell epithelioma of the cheek, inner canthus and right side of the nose. It was removed by surgical diathermy and later replaced with a lined sickle flap. Figure 2*a* illustrates the original lesion. Figure 2*b* shows the loss of the entire full thickness of the nose including the inner canthus and right cheek. Figure

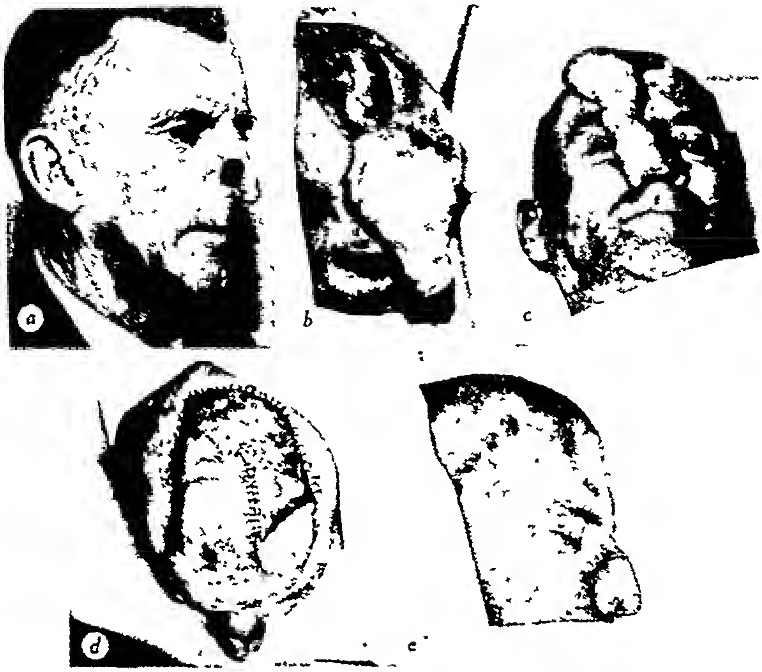


FIG 4*a* Postoperative defect *b* Flap in position *c* Flap after removal of sutures *d* After return of flap to the forehead *e* Reconstructed portion of the nose

FIG 5*a* Traumatic loss of the tip of the nose *b* Outline of the midline sickle flap. *c* Six months after reconstruction of the nose

2*c* was taken one year after completion of the reconstruction Note the reconstructed portion of the nose and cheek The remaining skin graft on the forehead has been replaced with a skin graft from behind the ear so that the color and texture are similar to those of the skin of the forehead

Case 3 illustrates the correction of a postoperative defect of the orbit and ethmoid region. The patient, thirty-nine years of age, had a postirradiated squamous cell epithelioma of the inner canthus and orbit, which was removed by surgical diathermy. He had had roentgen treatment for six years. The growth was fixed and it was necessary to remove the left eye along with it. A lymph node, which appeared in the parotid region, was removed by surgical diathermy. A sickle flap was used to reconstruct the postoperative defect. Figure 3*a* shows the postoperative defect and figure 3*b* shows the closure of the postoperative defect by means of a lined sickle flap. The sutures have just been removed.

Case 4 illustrates the use of the midline sickle flap from the scalp to replace the loss of the right half of the nose. The patient, forty-eight years of age, had a postirradiated cancer of the nose, which had been reconstructed utilizing the bay of the forehead to the right of the midline so that there was a scarring at this point and a sickle flap could not be employed. The midline sickle flap follows the same principle as the original one. The pedicle in this case was to the right of the midline and extended back into the scalp and then forward; therefore the bay just to the left of the midline was the portion employed to reconstruct the lost part of the nose. The flap was elevated and delayed. The distal end was lined and then brought down to the nose. Figure 4*a* illustrates the postoperative defect

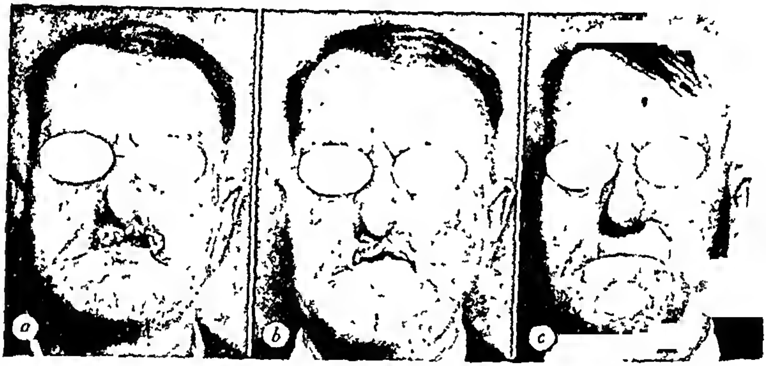


FIG. 6*a*. Basal cell epithelioma of upper lip. *b*. Postoperative defect. *c*. Reconstructed upper lip.

showing the scarring in the bay to the right of the midline on the forehead, which could not be utilized as an ordinary sickle flap. Figure 4*b* shows the flap down in position; the scalp area is grafted and the flap is tubed using parawax mesh gauze. Figure 4*c* shows the flap after the sutures have been removed. Figure 4*d* shows the flap after it had been returned to the forehead. The skin graft to the left and the completion of the suturing of the reconstructed part of the nose may be noted Figure 4*e* illustrates the reconstructed portion of the nose, which may be compared with figure 4*a* This photograph was taken immediately after the completion of the suturing and the replacement of the flap.

Case 5 illustrates the traumatic loss of the tip of the nose, which I feel is best corrected with a midline sickle flap rather than a lateral sickle flap because of the fact that the latter tends to pull the reconstructed nose to one side In this case, in which the patient was forty years of age, it was possible, after the flap was prepared, to delay bringing it down for about three months In this way, the tissues are easier to fold and a better nose is obtained than if the flap is brought down immediately following the preparation, when the flap tends to be thickened and more difficult to fold Figure 5*a* shows the loss of the tip of the nose and the anterior half of the ala. Figure 5*b* shows the outline of the midline sickle flap using a pedicle to the left of the forehead. The skin graft to the right of the midline of the forehead

Fig 7*a* Cancer of the upper lip, side of nose and cheek *b* Postoperative defect. *c* Postoperative defect one year later *d* Result of reconstruction

may be noted This photograph was taken immediately after the reconstruction of the nose Figure 5*c* was taken about six months later The small graft on the forehead may be noted

Case 6 illustrates the treatment of a cancer of the nose and upper lip and replacement of the nose and upper lip with a sickle flap. The patient, fifty-five years of age, had a basal cell epithelioma of the upper lip, which had been irradiated. Figure 6*a* illustrates the cancer of the upper lip, columella, left ala and anterior portion of the upper jaw. This was removed by surgical diathermy. A sequestrum formed and this was removed later. Figure 6*b* was taken fifteen months from the time of the operation. The postoperative defect, involving about three fourths of the upper lip, the columella and left ala, may be noted. Figure 6*c* shows the upper lip reconstructed by means of a sickle flap. The reconstructed lip is 6 cm. in length. The remaining skin graft on the forehead is 2.5 cm. in length, illustrating the stretching of the replaced sickle flap.

Case 7 illustrates a patient, forty-eight years of age, with a postirradiated cancer of the upper lip, side of the nose and cheek of ten years' duration (fig. 7*a*). The lesion had been excised and treated with radium and roentgen rays. It was fixed to the upper jaw. The growth was removed widely by surgical diathermy. Figure 7*b* shows the postoperative defect and the amount of tissue that it was necessary to remove in order to be wide of the growth. The defect of the nose, upper jaw, cheek, angle of the mouth and lower lip may be noted. Figure 7*c* shows the postoperative defect one year later. A sickle flap was employed. The distal end of the sickle flap was lined. It was split lengthwise; then it was brought down so that a portion of it reconstructs the nose and the lower part reconstructs the upper lip. Figure 7*d* shows the postoperative result.

The lateral sickle flap, as previously reported, or the midline sickle flap as illustrated in cases 4 and 5, is a very efficient method of correcting the loss of tissue about the face.

ANKYLOSIS OF THE CORONOID PROCESS OF THE MANDIBLE (AND ASSOCIATED SCAR LIMITATION OF JAW FUNCTION)[1]

JAMES BARRETT BROWN, Col., M.C. inact.
St. Louis, Mo.

LeROY PETERSON, Major, D.C. inact.
St. Louis, Mo.

BRADFORD CANNON, Lt. Col., M.C.
Boston, Mass.

CARL LISCHER, Major, M.C.
St. Louis, Mo.

In gunshot and shell fragment wounds about the coronoid process of the lower jaw there may result so much fibrous tissue formation or comminution of bone with fixation, or both, that ankylosis of the mandible occurs and mouth function is lost.

Treatment of this ankylosis varies, according to the extent of fixation. These variations include; active movement or exercises using a rubber block, forcible dilation of jaw blocking the mouth open, section of the fibrous tissue and blocking, removal of the coronoid process with or without blocking, and resection of the jaw below the ankylosis creating a false joint.

The fixation of jaw in this coronoid region may be as solid as a bony ankylosis of the joint. Careful study is necessary to determine where the fixation is occurring to carry out proper treatment. Whether or not only one area is involved, that is the condyle of the joint, or the coronoid region, cannot always be determined positively, but in injuries that point to the coronoid it is best to approach this region first.

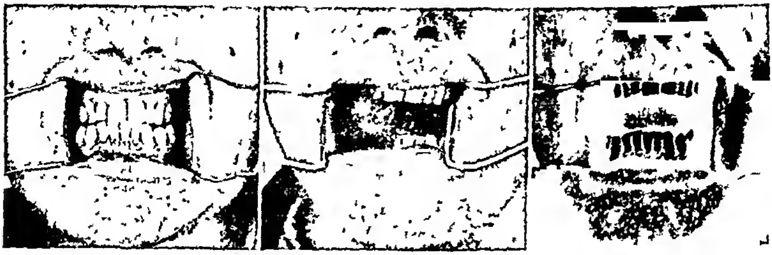
An ankylosing process involving the temporomandibular joint may extend to obliterate the sigmoid notch and also involve the coronoid process. Conversely, an ankylosis initiated in the region of the coronoid process might show the same tendency to extend and involve the temporomandibular joint. However, if ankylosis in the coronoid region can be treated early enough the process may not have time to involve the articulation.

In a series of 27 patients with limited mouth opening there were eight with actual bony ankylosis involving the coronoid process, three of which were associated with severe soft tissue cicatricial involvement. Five patients had only a strong fibrous attachment between the coronoid process and the zygomatic process. Of the remaining 14 patients, four had trismus due to the presence of foreign bodies in kinetic muscular areas, and in ten patients the trouble was attributed directly to scarring of muscle and surrounding tissues.

From this series it is recognized that one of the foremost causes of trismus,

[1] These patients have been cared for in association with Major C. P. Scarborough, Captain Joseph Murray, Major Byron West, Major Edwin H. Smith, D. C., Lieutenant Allyn McDowell, Lieutenant Milton Edgerton, Major Shearburn and Lieutenant Jensen.

or false ankylosis, is the formation of strong fibrous adhesions following laceration and ulceration of the soft tissues and muscles attached to the mandible about the coronoid process causing complete or partial limitation of opening. The missiles of war usually produce badly lacerated wounds, the tissues are irregularly torn, shredded and devitalized, and the injury is often complicated by fragmentation of bony structures. Treating such wounds by primary



A B C

FIG 1A Limitation of jaw opening due to deep scar fixation of the coronoid process on the rt side following gun shot injury

FIG. 1B. Mouth block in place following removal of coronoid process from inside of the mouth.

FIG 1C. Opening 3 weeks after removal of block Further opening obtained by using jaw exercising appliances and rubber block.

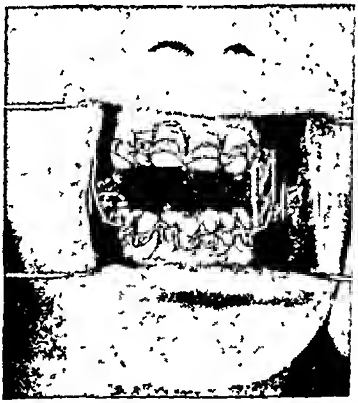


FIG. 2. Crib splint jaw dilating appliance Elastic traction utilized between extension arms. Splint made by Major Edwin H Smith, Jr., D. C.

closure may be inadvisable or impractical. As healing progresses binding scar tissue is formed. Patients with trismus due to soft tissue scarring present a serious surgical problem, and intervention may tend to cause more scar formation. The use of intra-oral flaps or skin grafts is not satisfactory usually. Superficial scar bands can be elongated by Z plasty or other local shift of flaps. Many patients can be aided by dilating the mouth under general, or

A B

FIG. 3A. Patient with typical appearance of unilateral ankylosing process, showing external wound and opening of mouth.

FIG. 3B. Post-operative view showing function gained.

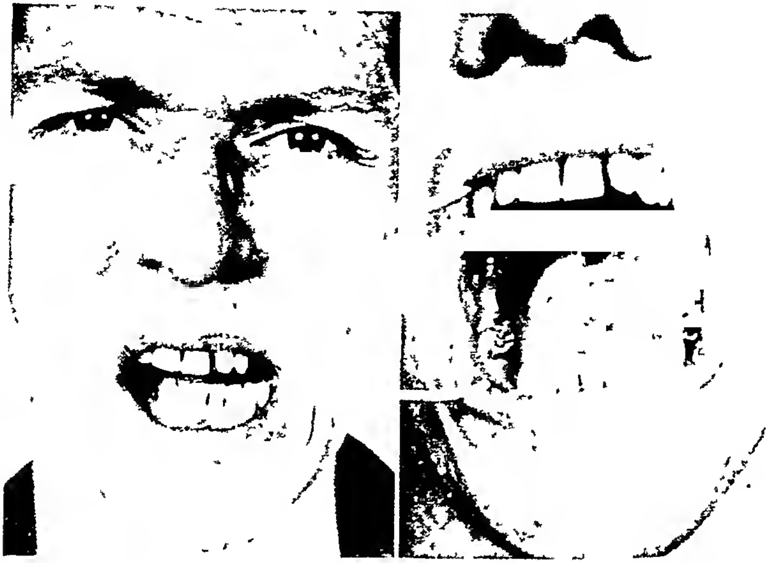
A B

FIG. 4A. Marked bony ankylosis of fractured coronoid process and depressed malar bone. Joint apparently uninvolved. Small metal fragment remains in place. Patient shown in 3A.

FIG. 4B. Post-operative x-ray showing removal of ankylosed coronoid. (New outline traced in) Patient shown in Fig. 3B.

deep block anesthesia, incising the scar transversely and blocking the mouth in open position for three weeks. A wedge shape wood block is used for the procedure. The block is wired to the teeth, after the desired or maximum open-

ing has been obtained, and covered with the dental compound to avoid irritation Following the removal of the block it is necessary for conscientious use of a



A B

Fig 5A Typical appearance unilateral bony ankylosis
Fig 5B Return of mouth function accomplished, following removal of bony ankylosis of coronoid and zygomatic process

A B

Fig 6A Pre operative x ray Old fracture of the zygoma and coronoid process of mandible clearly seen Pt shown in Fig #5 A and 5 B
Fig 6B Post perative film showing amount of coronoid process removed

dilating appliance to further insure a satisfactory jaw function Mechanical exercisers of various types have been used including elastic traction (fig 2)

and an ordinary rubber cork. The latter method is usually most effective with a little cooperation from the patient.

In some instances of soft tissue fixation it may be necessary to remove the coronoid as described under bone involvement, because the soft scar binds the coronoid to the fossa above.

A B

FIG 7A. Pre operative limitation of jaw function

FIG. 7B. Post-operative picture. Almost normal opening attained Jaw now deviates to the left side.

A B

FIG. 8A. Pre-operative x ray. Ankylosis existing between fragmented coronoid and fractured zygoma (Patient shown in Fig #7-A)

FIG. 8B Post-operative x-ray. Only a small section of the coronoid was removed. (Patient shown in Fig. #7-B).

In a few cases of very widespread, deep, soft tissue scar fixation which do not respond satisfactorily to the above method of treatment, a false joint or pseudo-arthrosis can be created below the binding action of the scar tissue by osteotomy of the ramus and removal of a section of bone.

The resulting flail joint is usually fixed by the surrounding scar and occlusal

unction is maintained. The patient is ordinarily able to masticate a regular iet.

Large metallic foreign bodies that lodge in kinetic areas may cause trismus nd discomfort, and usually, should be removed. This is not in contradiction o the usual teaching that deep healed foreign bodies should be left undisturbed, ut is a separate consideration of removing an irritant to the function of the jaw.

Bony ankylosis involving the coronoid process of the mandible may occur ong with fibrous fixation so that the coronoid cannot move because of attach-

A B C

Fig. 9A. Ankylosis following thru and thru shell fragment injury. Wound closed by condary healing.
Fig. 9B. Mouth opening gained following creation of a false joint operation done through ginal wound. Scar on opposite side severed also.
Fig. 9C. Post operative x-ray showing amount of bone removed.

ent to the zygomatic process, the maxilla, or deep in the fossa above. The fect is the same whether an actual bony union occurs or not, and resection the condyle from the inside of the mouth is frequently necessary.

Surgical treatment for bony ankylosis involving the region of the coronoid rocess is removal of the coronoid and enough of the surrounding displaced one to prevent re-union. No lining of mouth should be removed but deep ft tissue scar may have to be excised, and as mentioned above there may be much scar without actual bony ankylosis that the bone has to be removed

to permit function. In treating ankylosis of the temporomandibular joint a flap or free transplant of fascia is sometimes placed over severed both ends, but this is not necessary in this operation if enough bone is removed.

The crux of the operation is removal of a wide enough section of bone and binding scar to allow permanent movement in the area. In instances of bony ankylosis without associated extensive scarring no attempts are made to dilate the jaw for several days, but the patient is encouraged to exercise the jaw as soon as possible without undue discomfort.

The surgical removal of an ankylosed segment or release of fibrous adhesions is accomplished intra-orally. Endo-tracheal ether or novocaine cranial block anesthesia is used. An incision is made along the anterior border of the coronoid process from the upper fornix down toward the lower fornix, and the ascending ramus is exposed by blunt dissection. The ankylosed segment is then located and chiseled free. Usually the entire coronoid process is removed creating a large enough defect so that re-union cannot occur. The procedure is the same for both osseous and extensive fibrous ankylosis. Directional sutures are placed to close the mucous membrane and gauze drain lightly placed in the defect. Post-operative edema is controlled by applying an external pressure dressing.

The ankylosis usually exists between the fragmented segment of the coronoid process and the zygomatic or malar bone but there may also be enough displacement so that the posterior region of the maxilla is involved.

In many cases where a small bony attachment exists, it is important to free all the tendonous attachments of the temporal muscle before chiseling loose the ankylosed segment. If this is not done, the resultant temporal muscle spasm will displace the freed tip of the coronoid process into the region of the temporal fossa where it is difficult to recover.

Usually, there is only a minor amount of bleeding encountered during this surgical procedure, but should one of the larger branches of the internal maxillary artery be encountered, the bleeding can be controlled by packing the wound and the use of a pressure dressing.

Removing the coronoid process decreases the probability of further facial deformity that may be caused if a portion of the malar bone is removed. The intra-oral approach also avoids possible post-operative complications due to involvement of the facial nerve and parotid gland structures. Post-operative jaw exercises are of paramount importance in gaining normal function and the simple use of a rubber block and active motion usually suffice.

FACIAL ASYMMETRY AND MALOCCLUSION FROM HYPERPLASIA OF THE MANDIBLE

Correction by Operation

JAMES BARRETT BROWN, M.D., LEROY PETERSON, D.D.S.

St. Louis, Mo.

BRADFORD CANNON, M.D.

Boston, Mass.

AND

ANDREW M. MOORE, M.D.

St. Louis, Mo.

Facial asymmetry and malocclusion resulting from a unilateral hyperplasia of bone in the body and ascending ramus of the mandible is not unknown in the literature but is rare in occurrence, and an instance of its occurrence and its correction by resection of the condyle and its neck is recorded here. Other reports have been made by Ivy, and Curtis Thoma, Werrig and Kaplan.

The process is one that gives some hesitation in diagnosis, prognosis, and in selection of treatment. The patient illustrated here presented all the difficulties of decision, and it is to her persistence that something be done that much of the credit for the acceptable result must be given.

No mention was made regarding the abnormality of the teeth or jaw at the time of commission of this 27 year old army nurse. She first had symptoms associated with the left mandible in September 1941 because of an infected, impacted, lower third molar. The dentist at that time commented on the asymmetry of the left mandible when he removed the tooth. The patient continued to notice progressive enlargement of the jaws during the next three year interval, with pain in the left temporomandibular joint and increasing malocclusion. The asymmetry progressed until January 1945, at which time the lengthening of the mandible apparently subsided. Other history and the family history is essentially negative.

Positive findings in the clinical examination are limited to the jaw. No systemic dyscrasias of any kind were made out on careful general studies. The face was enlarged markedly on the left, with flattening and appearance of submaxillary tumor formation, and the examination of the mandible showed that the patient's asymmetry was due to an increase in length of the ascending ramus and also of thickening in the body of the left jaw.

The second and third molar teeth were missing and the entire left side, extending from the central incisor back, was out of occlusion. There was a discrepancy of approximately 6 mm. in the bicuspid and first molar area.

Study models were made and it was thought that the occlusion could be markedly improved by resection of the condylar head and neck, and there had been no decided shifting of the teeth and they would come into occlusion. It

was recognized that the entire facial deformity probably would not be corrected by removing part of the ascending ramus, as there was also thickening of the body of the mandible

X-rays of the mandible showed no tumor formation but only a marked asymmetry between the right and left sides, with the main change being an elongation of the neck of the condyle and deepening of the sigmoid fossa, and a thickening

1 2

FIG 1 AND 2 PRE-OPERATIVE VIEWS SHOWING FACIAL ASYMMETRY AND MALOCCLUSION

FIG 3 SYMMETRY GAINED FOLLOWING REMOVAL OF CONDYLAR HEAD AND NECK

FIG 4 RESULTANT OCCLUSION WHICH WAS IMPROVED WITH ELASTIC TRACTION

of the lower part of the body on this side No structural bone changes were noted

The patient persisted in wanting something done, and because of her earnestness, and of other elements of her adjustment, operation was undertaken

Operation The condyle and its elongated neck were removed fairly easily through an incision curved down from the temple, staying close into the crus of the helix and over the tragus The wound was closed with drainage

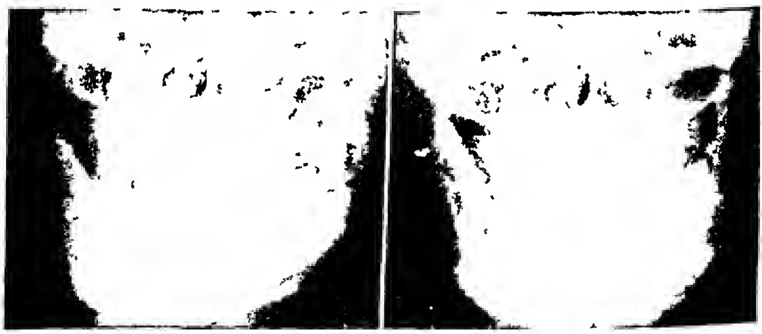
The postoperative course was uneventful and the teeth were brought into

occlusion, utilizing elastic traction attached to previously placed multiple loop wiring. There was no involvement of the facial nerve nor other surgical complication.

Elastic traction was maintained for four weeks, following which good jaw movement was obtained after the initial inflammatory reaction subsided. The mandible functions through a false joint on the left side, and the patient is able to masticate her food quite satisfactorily. It is to be noted that when the

5 6

FIGS. 5 AND 6. PRE-OPERATIVE AND POST-OPERATIVE X-RAYS. NOTE INCREASE IN WIDTH OF BODY OF MANDIBLE



7 8

FIGS. 7 AND 8 PA X-RAYS. OCCLUSAL ADJUSTMENT AND CORRECTION OF ASYMMETRY CAN BE SEEN. (REVERSED IN PRINTING)

deforming effect of the long condylar neck was removed the temporal and masseter muscles readily elevated the left side of the mandible. The facial asymmetry was improved more than was anticipated and the final result was quite pleasing. The growth process in the ascending ramus was apparently due to a hyperplasia of the condylar epiphysis as the coronoid process was not involved.

Microscopic Examination: Bony substance essentially normal in appearance, and there was no indication as to the cause of the enlargement. One section

included the articular surface, and here there was profound regeneration of cartilage with denudation and exposed bone.

Diagnosis: Degenerative joint disease.

SUMMARY

A young woman of pleasing appearance in general developed a serious facial deformity. This proved to be due to an enlargement of one condyle and its neck, and resection allowed return to normal occlusion and function and contour.

AN ORIGINAL METHOD OF CORRECTION OF HYPERPLASTIC ASYMMETRY OF THE MANDIBLE[1]

J. WALLACE McNICHOL M.D.[2]

Hamilton, Ontario, Canada

AND

A. T. ROGER D.D.S.[3]

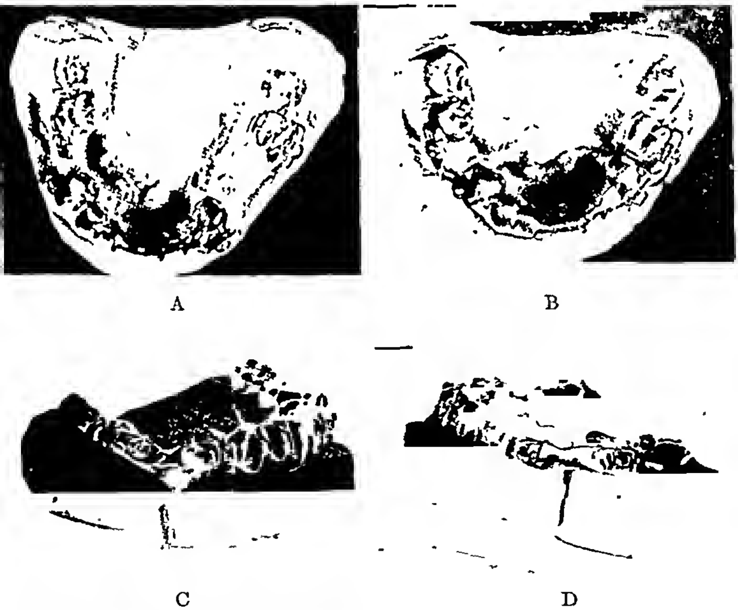
Ottawa, Ontario, Canada

This problem is fortunately uncommon as its correction is difficult. There are only 31 cases reported in the world's literature, including the authors'. The first case was described by Adams in 1836 (1). The patient was a female, age 35, who died in 1840 and, following an autopsy, it was found that superimposed upon a hyperdevelopment of the right side of the mandible was a well advanced rheumatoid arthritis of the right temporo-mandibular joint. This case is, therefore, not a pure example of asymmetry of development of the mandible. (See fig. 1.) It is worthy of note, however, that Adams stated that, "The neck was more than an inch long and was double the size of the neck on the opposite side." The feature of an abnormal increase in the length of the condylar neck out of proportion to the increase in size of the coronoid process or ramus is a pathognomonic feature of this condition and is due to an abnormal increase in growth of the condylar neck, which is a downward growth from the precartilaginous tissue beneath the surface fibrocartilage (not a true epiphysis). The ramus on the affected side, as well as being longer, is pushed downwards and has a lateral convexity, whereas the ramus on the unaffected side has a lateral concavity. The deformity increases most rapidly during puberty and frequently only becomes clinically evident at that time. It involves the entire mandible to a minor or major degree, as described above, and is commonly associated with other developmental variations of the face, such as asymmetry of the two sides of the maxilla and malar bones. It is also associated with other first arch deformities which commonly involve the ears. Acromegaly differs markedly from unilateral hyperplasia, in not only being bilateral but also in the fact that new growth occurs at the same time in other parts of the mandible.

The bite and its plane of occlusion is usually involved in the process. When such is the case, the difficulties in planning reconstruction are greatly magnified. It is not justifiable to interfere with a bite, even though it be abnormal, unless a new functional occlusion can be assured, when the old bite is adequate to allow the individual to grow up and, as in the case to be presented, is Army Medical Category A 1. If a new functional occlusion can be achieved, the procedure is well justified on psychotherapeutic grounds.

[1] Passed by Canadian Military Headquarters, London, England, for publication.
[2] J. Wallace McNichol, Major, RCAMC—In charge of Plastic Surgery, Canadian Army Overseas, June 1945 to May 1946.
[3] A. T. Roger, Major, CDC, Dental Surgeon with Plastic Surgery Service, Canadian Army Overseas.

IG. 1. First case in literature—described by Adams in 1836. This case has a late stage nic rheumatoid arthritis of the right temporo-mandibular joint superimposed and there-is not a pure example of asymmetry of development of mandible



:. 2. DENTAL MODELS WITH SECTIONAL CAST CAP SPLINTS *in situ* BEFORE AND AFTER SECTIONING

A. Before sectioning.
B. After sectioning. Note prefabricated "lock bars" now in place in this and profile ws joining and holding the three sectional cast cap splint on the model in its newly ermined position.
C. Right profile; only one sectioning of model was done at this point.
D. Left profile; sectioning of model as shown, with removal of portion making up 2nd ver left premolar and 1st molar and associated bone.

Fig. 3. Childhood Family Photographs

A. Age 19 months.
B. Age 2 years.
C. Age 5 years.
D. Age 9 years.
E. Age 13 years; note, this is the first photographic evidence of change of shape of mandible, which is just at the beginning of puberty.

METHOD OF DEVISING NEW FUNCTIONAL OCCLUSION

The first step in determining the possibilities of bite adjustment is to obtain plaster models of the dental arches, and to record on them the existing occlusion. The lower model is then cut, reduced in size if necessary by removal of teeth, and re-positioned in relation to the upper with a view to correcting the facial deformity and at the same time producing a functional occlusion. The sections of the lower model can then be joined with a little fresh plaster. This new model will indicate which teeth must be extracted, and will act as a guide to the best locations for sectioning of the mandible. (See fig. 2.)

A method of fixation of the mandibular fragments must be decided upon. Sectional cast cap splints of German silver cemented to the teeth are usually the most efficient. Removable locks will be required for application following

FIG. 4 VIEW OF PRE-OPERATIVE BITE

mandibular sectioning and these may be prefabricated by making a plaster model of the lower arch with the splints on the teeth and then cutting and adjusting it with reference to the pre-determined bite. Provision should be made for intermaxillary fixation to give greater stability by placing hooks for wires or additional locks on the splints.

METHOD OF CORRECTION

After calculation of the new occlusion, as described above, which should be achieved before any surgery is undertaken, the cast cap splints are cemented on the teeth. The patient is then ready for operation, which has to be undertaken in stages, varying in number according to the individual case.

First stage. Bilateral complete section of the mandible at previously planned

points, with removal of full thickness section on "long" side, together with its associated teeth, and removal of excess bone (e.g., prominent sagging inferior border of body of mandible on "long" side). The procedure deliberately sacrifi-

FIG. 5. PRE-OPERATIVE VIEWS FOLLOWING ADMISSION TO HOSPITAL

ces bilaterally the mandibular nerves and vessels at the points of section with subsequent loss of innervation to the teeth lying distal and sensation to the lower lip. The patient quickly accommodates himself to this loss of sensation. The denervation of the teeth is believed justifiable in view of the aesthetic im-

provement and it is felt that the prognosis for their continued function is fairly good. However, the patient is advised to have a regular radiological examination. If or when extraction and a prothesis is required, the alveolar ridge will be in a more favourable position relative to the upper arch.

Second stage. Bilateral cancellous bone grafts to points of previous bilateral section, 3 to 4 weeks after the first stage, when the openings previously made in the mouth have become well healed. Any further excess prominent bone can be removed at this time.

Third stage. Five to 6 weeks later—filling out of the concave side of the face by a soft tissue fat fascial dermal graft.

FIG 6 PRE-OPERATIVE X-RAYS
Note curves of rami, difference in angles and inferior borders

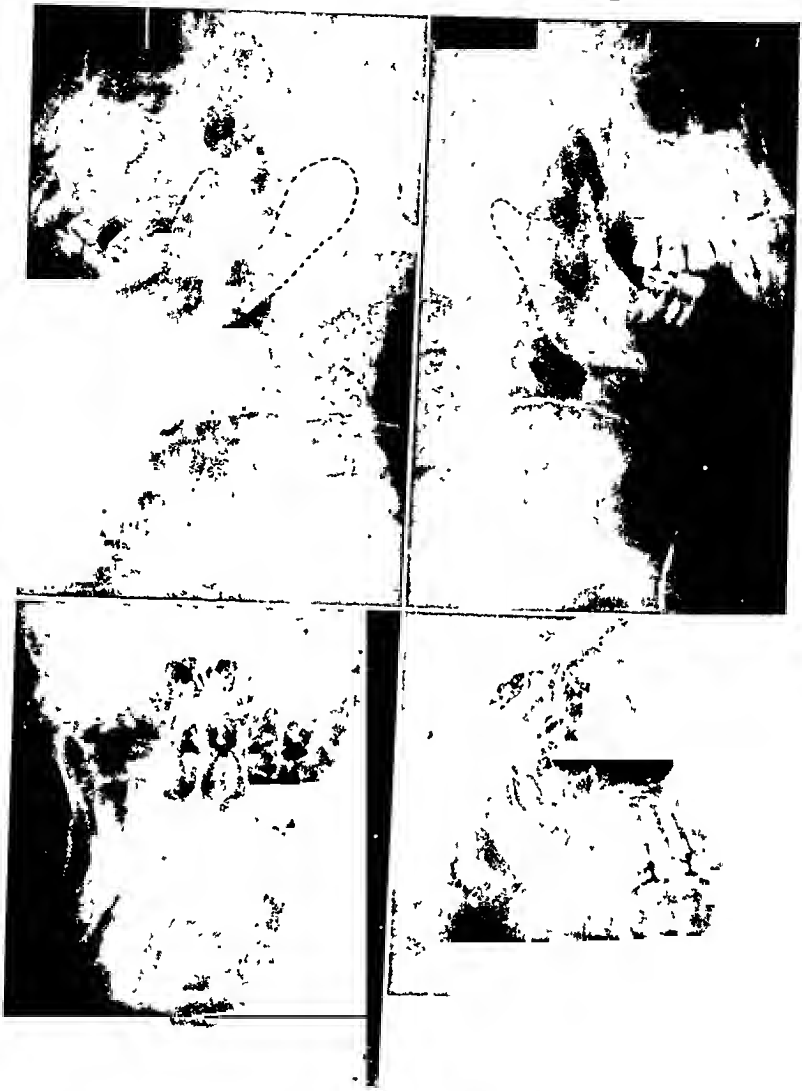
The operative treatment by others in the attempted correction of the deformity has been a resection of the head of the condyloid process on the affected side which, although it equalized the length of the rami and produced a false joint on the affected side, did not result in a good functional occlusion, nor did it alter shape of the body of the mandible and the concavity on the unaffected side of the face and, therefore, is only a partial correction of the deformity

CASE REPORT

C. W D , Pte age 20 Admitted July 30, 1945

History At age of 5 years, fell on his face while playing on a swing (It is very questionable whether this fact is of any significance) Patient states that as far as he knows, his

A B



C D

FIG. 7. Post-operative X-Ray photographs showing abnormally large and long condylar head and neck out of proportion to size of coronoid process on the left side, which is apparently almost entirely responsible for the apparent hyperdevelopment on the left side. The right side is normal. Because of the density of the X-Ray plates the bony outlines of the above-described have been marked for clarity.

A. Left oblique view showing greatly enlarged condylar head and neck and less enlarged coronoid process.

B. Right oblique view showing normal condylar head and neck and coronoid process. X-Ray still shows evidence of point of surgical section of mandible [illegible] after surgical section and 183 days after cancellous bone graft alt[illegible] strong.

C. AP view showing no change in shape of rami but shape of body altered only to a degree consistent with function.

D. Lateral view showing even relationship of inferior borders of body of mandible with no change in relationship of posterior borders of rami.

face was symmetrical until about the age of 13, when parents noticed a change and consulted a doctor.

The picture taken in 1939 (age 13) shows the first definite evidence of asymmetry which was present in a mild degree. (See fig. 3).

General examination. Normal, well developed adult male.

Special examination. A marked shift of the entire mandible to the right, so that the midline between the lower central incisor teeth lies at the junction of the lateral one-third and the medial two-thirds of the upper right central incisor tooth. From this point to the right, the lower teeth lie buccal to the upper and to the left of the midline the bite is relatively normal. (See fig. 4 of the original bite.)

Clinically, the centre of the chin is in direct line with the right pupil. The hypoplasia of the right side is further exemplified by less prominence of the right cheek, and the face is

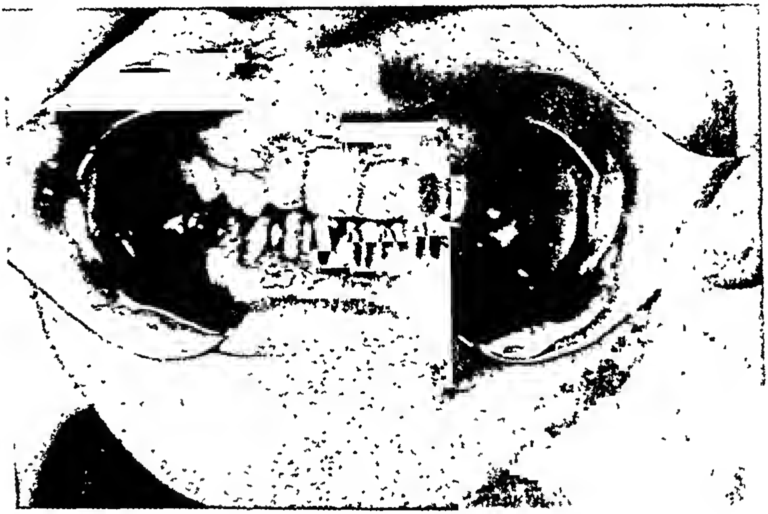


FIG. 8. NEW FUNCTIONAL OCCLUSION AFTER INTERMAXILLARY FIXATION HAS BEEN REMOVED BUT CAST CAP SPLINT STILL *in situ*

shorter in a cephalic-caudal plane through the right eye than the left There is also elevation of the right commissure of the mouth. The slight change in position of the right ear is in line with a first arch deformity. (See pre-operative views—fig. 5.)

Radiologically, the right ramus is concave laterally, the left convex laterally The symphysis portion deviates strongly to the right. This suggests an hypoplasia of the right half of the mandible but this does not seem a satisfactory explanation as the left angle is not well formed. (See pre-operative X-Ray plates—fig. 6.) Unfortunately the only good X-Rays for reproduction, showing the right and left condylar heads, are post-operative. The pathognomonic feature of the very greatly enlarged left condylar head and greatly elongated left condylar neck are evident. The left coronoid process is also enlarged but not in proportion to the head and neck. The right condylar head and neck and coronoid process are normal. (See post-operative X-Ray plates—fig. 7.)

The laboratory tests, including Kahn, were negative.

Operations

Pre-operative cementing of three sectional German silver lower cast cap splints to teeth.

First stage. Bilateral full thickness section of body of mandible, with total removal of

rectangular section on left side through submandibular incisions The associated 2nd lower left premolar and 1st molar teeth were first extracted The point of section on the

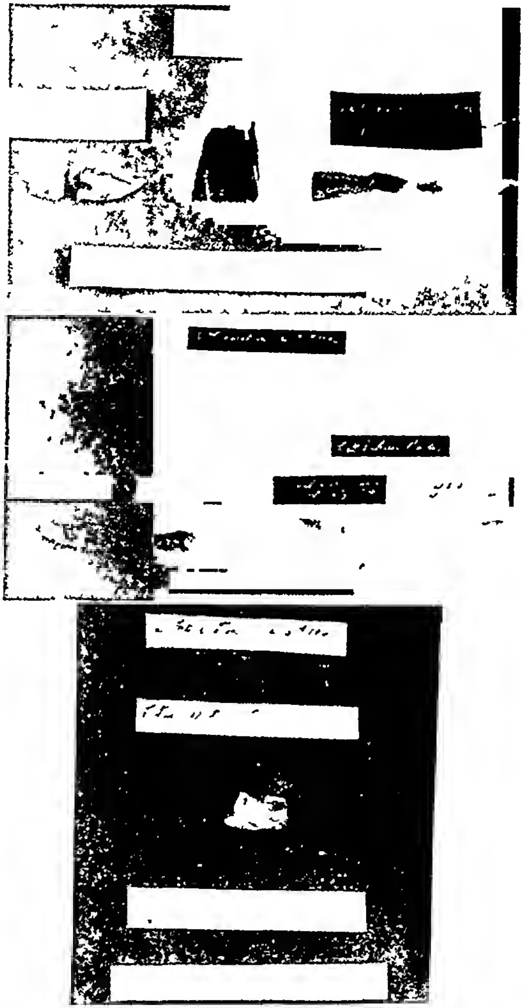


Fig 9 Bone Removed at Three Operative Stages
1st stage—September 3, 1945
2nd stage—October 5, 1945 (32 days post 1st stage)
3rd stage—November 15, 1945 (41 days post 2nd stage)

right was already edentulous The left inferior border of the mandible was also removed as it hung down like a jowl from the point of section to the left angle Prominent areas of bone in region of the right section which became exaggerated in prominence after the symphysis

fragment was immobilized in its new position by locking bars on the cast cap splint, were also removed. Further fixation was achieved by intermaxillary wires. (See photo of new occlusion, fig. 8.)

Second stage (32 days post first stage). Bilateral cancellous bone grafts (donor iliac crest) to body of mandible at points of section, together with further removal of excess prominent bone on right and left sides.

Third stage (41 days post second stage). Total removal of right mental tuberosity, with associated buccal surface on right side because, in spite of the symphysis being in the midline, there was undue prominence of this area. (See fig. 9 of bone removed.)

Fourth stage (21 days post third stage). Fat fascial dermal graft to right side of face

FIG. 10. POST THIRD OPERATIVE STAGE

After completion of all bone surgery on the mandible and achievement of new functional occlusion, and prior to the correction of the soft tissue deformity on the right side of the face by a fat fascial dermal graft (donor abdominal wall). Note exaggeration of the concavity of the right side of the face after the removal of the right buccal surface and right mental tuberosity. This emphasizes the important point that all bone surgery should be completed before the soft tissue defect is corrected. (Compare full face photo with original pre-operative *Fig. 5.*)

(donor anterior abdominal wall) to fill out concavity. (See fig. 10 after third stage and prior to fourth.)

Fifth stage (37 days post fourth stage). Additional fat fascial dermal graft to fill out residual concavity to right side of face. (See final post-operative, fig 11)

SUMMARY AND CONCLUSIONS

1. An original method of correcting a complicated problem of hyperplastic asymmetry of the mandible has been presented.

2. The importance of devising a new balanced occlusion pre-operatively has been stressed.

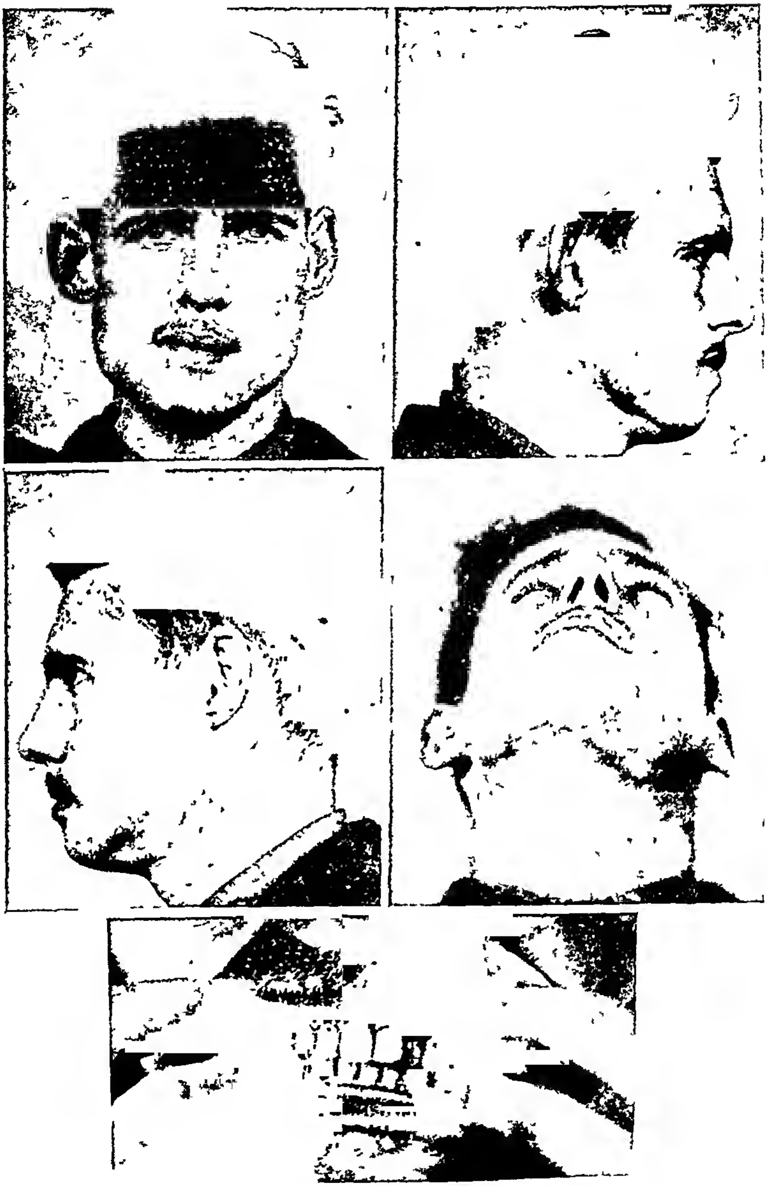


FIG. 11. FINAL POST-OPERATIVE VIEWS SHOWING FACIAL CONTOUR AND NEW FUNCTIONAL OCCLUSION. 84 DAYS POST LAST OPERATION

Final post-operative view.
Final post-operative view.
Final post-operative view.
Final post-operative view of new functional occlusion.

3. The psychotherapeutic value of the end result greatly outweighs the sacrifice of sensation to the lower lip and teeth distal to the points of section.
4. The value of combined team work on such a problem is clearly illustrated.

The authors would like to thank Mr. M. A. Rushton for the use of his material in the preparation of the historical background.

They also wish to express their appreciation for the combined clerical and photographic work done by Pte. C. R. Cooke, Pte. M. E. Trussler, Mr. L. C. Quartermain and Miss A. M. Graham.

A SUMMARY ON THE WORLD'S LITERATURE ON THE 30 CASES OF HYPERPLASIA OF MANDIBULAR CONDYLE REPORTED

1836 ADAMS, R. One case. "Treatise on Rheumatic Gout," 2nd Ed., 1873, London & Atlas, Plate I.
1856 HUMPHREY, G. M. One case. Assoc. Med. Journ., N.S., 4: 61.
1883 EVE, F. S. One case. Trans. Patn. Soc. Land., 34: 187.
1883 HEATH, C. One case. Trans. Patn. Soc. Land., 34: 185. Injuries and Diseases of the Jaw. 3rd Ed., London, 418.
1884 HEATH, C. One case.
1898 GRUBE. One case. Dissert. Kiel.
1899 ECKERT, E. One case. Beitrage z. Klin. Chir., 23: 674.
1906 EISELBERG. Two cases.
1906 RIEDEL. One case. Verhandl. d. deut. Ges. f. Chir., 1: 148.
1907 VOELKER. Three cases. Verhandl. d. deut. Ges. f. Chir., 1: 147.
1919 LOHMANN AND PERTHES. One case. Dissert. Tuebingen.
1922 PERTHES. One case. Zentralblatt f. Chir., 49: 1540.
1926 GRUCA AND MEISELS. Three cases. Ann. Surg., 83: 755.
1926 WEMUTH. One case. Zeitschr. f. Stomatol., 24: 874.
1927 IVY, R. H. Two cases. Ann. Surg., 85: 27.
1927 DUFOURMENTEL. Two cases. Bull. Mem. Soc. Chir. Paris, 19: 126, 341.
1934 BRODIE. One case. Angle Orthodent., 4: 160.
1944 RUSHTON M. A. One case. Growth at the Mandibular Condyle in Relation to Some Deformities. Reprint from Brit. Dental Jn., 76.
1945 THOMA, K. H. Two cases. Amer. Journ. Orthodent. & Oral Surg., 30: 597.
1946 RUSHTON, M. A. Two new cases. "Unilateral Hyperplasia of the Mandibular Condyle." Proc. Roy. Soc. Med., May, 1946.
1946 WORMAN, H. G., WALDRON, C. W., AND RADUSCH, D. F. Oral Surg., 4: 27.

THE TREATMENT OF MICROGNATHIA ASSOCIATED WITH OBSTRUCTION BY A PLASTIC PROCEDURE[1]

BEVERLY DOUGLAS, M.D.

Nashville, Tennessee

The unsatisfactory status of measures to combat the obstructive dyspnoea which is an ever present symptom of micrognathism led Davis and Dunn (1) in 1933 rightly to conclude that "a search of the literature of micrognathia reveals few suggestions for correction of this deformity other than appliances which have the disadvantages of being cumbersome, difficult of retention, insanitary, and requiring a closed mouth."

The fact is that even at present no form of apparatus is considered satisfactory for relieving obstruction due to micrognathia over a long enough period of time to make it worth while.

The operation described herewith was developed with the purpose of anatomically correcting the faulty position of the tongue which causes the obstruction. Thus apparatus is entirely avoided as unnecessary.

Micrognathia, or small lower jaw, is frequently associated with respiratory obstruction, whether cleft palate is present or not. The intermittent respiratory dyspnoea, with sternal retraction, characteristic of this condition is very distressing and frequently results in a fatal outcome when treated expectantly.

The operation described has proven successful in relieving this dyspnoea, immediately and permanently, in a very high precentage of cases.

ANATOMY AND PHYSIOLOGY

We have given the name of "linguo-epiglottic obstruction" to the form of obstruction associated with micrognathia. The reason is obvious. The obstruction appears on laryngoscopic examination to be due to the tongue falling backward and downward into the throat (see report of laryngoscopic examination under case 1). Through the laryngoscope the tongue is seen actually to drop down over the epiglottis in such a way as to act as a ball valve allowing egress but preventing ingress of air. This accounts for the fact that sternal retraction is such a prominent feature in these cases.

A study of the normal anatomy as shown in figure 1 shows that the tongue is normally held forward by the attachment of the genioglossi muscles to the mental spines near the symphysis of the mandible and the frenulum linguae at the same site. In micrognathia the front of the mandible is so far back in position that the tongue has little, if any, support. It, therefore, falls downward and backward and causes obstruction.

SYMPTOMATOLOGY

We are indebted to Dr. Katharine Dodd, formerly of the Department of Pediatrics at Vanderbilt, now of the Department of Pediatrics at the University

[1] From the Department of Surgery, Vanderbilt University.

of Cincinnati, for the excellent description of the symptoms and signs in a typical case in 1937 and feel that her description should be called the "Dodd Syndrome."

She pointed out the association of cleft palate, short, poorly developed lower jaw, and tongue swallowing accompanied by difficult inspiration, sternal retraction and cyanosis. She emphasized the fact that breathing is particularly difficult if such infants are allowed to lie on their backs or are held up to nurse.

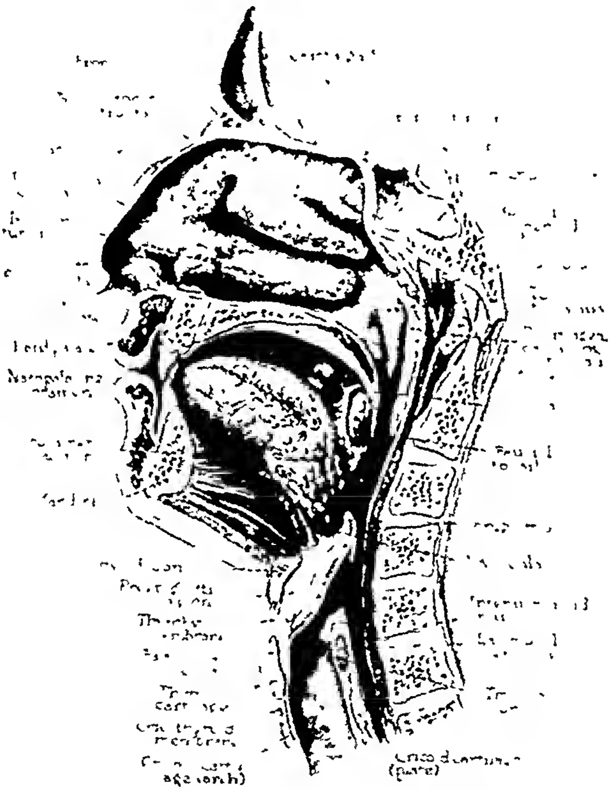


FIG. 1. NORMAL ANATOMY (FROM LEDERER—"DISEASES OF THE EAR, NOSE AND THROAT,") SHOWING ATTACHMENT OF TONGUE ANTERIORLY THROUGH GENIOGLOSSI MUSCLES TO MENTAL SPINE NEAR SYMPHYSIS OF MANDIBLE

It is to be noted that the frequency and severity of the attacks of dyspnoea vary with the amount of mechanical obstruction caused by the tongue. In many, but not all, of our cases dyspnoea and cyanosis were noted at birth. In other cases the difficulty of feeding overshadowed the inspiratory difficulty of linguo-epiglottic obstruction, and yet operation was necessary for the solution of the feeding problem.

These cases of micrognathism are not to be confused with the case described by New (2) as one of "Congenital flaccid tongue and palate." In the latter micrognathia was absent. The obstruction by the tongue was both inspiratory and expiratory, and complete relief was obtained by the retention of a special, short, celluloid catheter apparatus placed in the pharynx between the tongue and palate. The author felt that a neurosis may have been the cause of this condition.

FIG. 2. CASE 1. SHOWING EXTREME BACKWARD DISPLACEMENT OF CHIN DUE TO MICROGNATHIA

REPORT OF CASES

Case 1. Baby M., delivered December 16, 1938. Seen through courtesy of Pediatric Service. Physical examination December 19, 1938 Dyspnoea, retraction of sternum on inspiration, cleft palate, receding chin as shown in figure 2. The inability to nurse from the breast was thought to be due to cleft palate. Feedings gavaged beginning December 18. Dyspnoea and sternal retraction were present with very rapid inspirations.

It was thought that the infant had aspirated milk and had an aspiration pneumonia. Congenital atelectasis was also suspected. Put in oxygen tent December 19. Symptomatically better. Laryngoscopic by Dr. Maness December 21 showed no abnormality of larynx but tongue fell down and back in such a way as to allow egress but to prevent ingress of air.

Taken out of oxygen tent December 23 but had severe attacks of dyspnoea and cyanosis. Better, however, when on his right side. December 23 in consultation I advised that tongue be tied by operation and milk-bottle crutch be made

At operation December 24, 1938, a silk suture was first placed through the tongue for traction 0.5 cm. from the tip. The tongue was held forward by this stitch in order to prevent swallowing. A rectangular area of mucous membrane extending over the tongue, gum and lip was outlined by a stitch at each corner as follows:

One at each end of a transverse line a, b (see fig. 3) right, 1.5 cm. in length on the underside of the tongue 1 cm. posterior to its tip; one at each end of a similar transverse line c, d 1.5 cm. long placed 1 cm. posterior to the free convex border of the lower lip. The mucous membrane of the underside of the tongue extending down into the sulcus between the tongue and gum, up over the gum, down into the sulcus between gum and lip, and up on the posterior surface of the lip to the line c, d was excised thinly with a small scalpel in one rectangular piece by making traction on the stitches. The orifices of Wharton's ducts in the sulcus were circumscribed in order to avoid division. The raw surface on the tongue was brought down

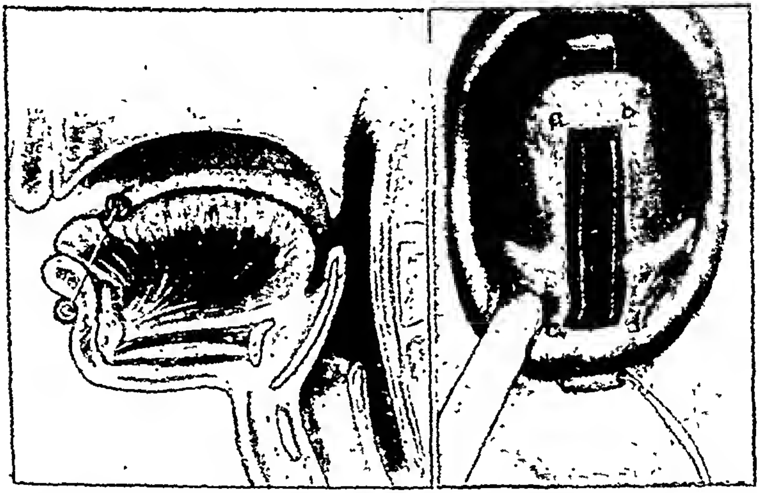


FIG. 3. TECHNIC OF SURGICAL SUSPENSION OR FUSION OF TONGUE TO LOWER LIP FOR RELIEF OF THE INSPIRATORY OBSTRUCTION OF MICROGNATHIA
Right—position of tension suture after excision of mucous membrane.
Left—Raw surfaces on tongue, gum and lip approximated;
Line——— ——— Position of suture.
Line . . . Raw surfaces approximated.
Line — — — — — — — — — Former position of tongue.

over the freshened gum into apposition with the raw surface of similar size on the posterior surface of the lower lip by sutures as follows:

A lateral mattress tension suture of medium silkworm gut entered the skin in one side of the sulcus approximately 1 cm. below the free border of the lip, passed out near the corresponding corner of the raw surface of the lip, over the freshened gum, through the corresponding corner of the raw surface on the underside of the tongue, through the tongue and out its dorsal surface through a small piece of Fr. 12 catheter to retrace its course at the opposite corners, and out of the lip on the other side of the sulcus. A similar piece of catheter was threaded over the suture and the stitch tied snugly to bring the tongue forward and into apposition with the lip (figs. 2, 3, 4,) A few 0000 plastic silkworm sutures on atraumatic needles through the apposed edges of mucous membrane on the tongue and lip completed the closure. The stripping of mucous membrane may be facilitated by the injection under it of a little saline solution containing four drops of adrenalin to the ounce.

Postoperative course: The cyanosis, which had only been relieved by holding tongue and

jaw forward, was immediately remedied. All artificial procedures were omitted except gavage, which was stopped in a few days.

Pediatric report December 29. "Doing very nicely. No dyspnoea in any position. No cyanosis"

X-ray findings December 20, 1938. "Elevation of diaphragm on both sides. There is a little haziness in both lungs, indicating partial atelectasis."

December 28, 1938, (four days postoperative) rather marked increase in broncho-vascular shadow but atelectasis has almost entirely disappeared.

December 20, 1938, x-ray of jaw shows small mandible with incisors evidently on level far back of uppers

As was expected, the constant movement of the tip of the tongue caused a slight cutting of the superficial sutures anteriorly, but the mattress suture through the lip held the tongue

Fig. 4. Case 1. Showing Silk-worm Mattress Suture over Rubber Tubing Holding Tongue in Contact with Lip

downward and forward until adhesions had formed at the site of the frenum. Therefore, when the stitches were removed on the eighth day, no tongue-swallowing occurred.

A lip-guard was made according to the design of Davis and Dunn (1). This apparatus consists of a cap sleeve with a solid perpendicular rod and lip-guard fastened to an ordinary nursing bottle by a set-screw. The crutch-like portion, which in nursing or taking water rests against the upper lip and forces the infant to protrude his lower lip and jaw, is being gradually adjusted to a position further and further ahead of the rubber nipple. It has been used faithfully ever since to force the infant to move his lower jaw forward in suckling as shown in figure 5.

The patient's lower jaw in three months seemed already to have lengthened definitely. On March 27, 1938, he had made a gain of nearly five pounds in weight.

After growth of the mandible has proceeded to a normal length, we relieve the intentional tongue-tie by the usual plastic operation for the latter condition. This may be done at any time before speech would be affected.

Case 2. H. D. M. born February 8, 1940. Normal delivery at term. Admitted from delivery room. Family history—brother of patient described under case 1. Physical examination revealed marked retraction of lower jaw. Lower gum line 1.5 cms. posterior to upper gum line. Palate cleft from level of premolar teeth backward through uvula. Impression: Micrognathia and post-alveolar cleft (palate), partial.

Preoperative course: Within a day of birth it was noted by the pediatricians that the patient had difficulty in nursing from the breast but could take water lying on his side. After three days it was noted that the micrognathia caused a partial obstruction at the epiglottis which interfered with feeding. Various formulas and methods of feedings were tried, with no improvement. The weight dropped from eight pounds eight ounces at birth to seven pounds eleven ounces by the thirteenth day, at which time the patient was transferred to Surgery.

Operation February 22, 1940. Operation identical to that carried out on the patient reported under case 1; viz, plastic operation to suspend tongue forward by anastomosis of

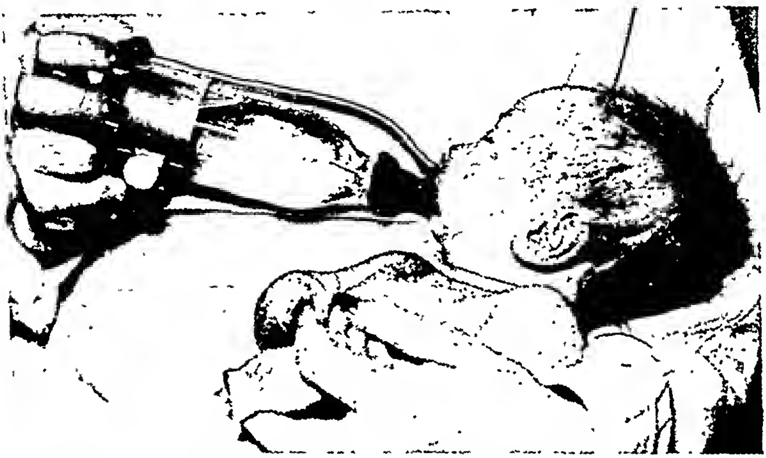


FIG. 5. BOTTLE-GUARD APPARATUS OF DAVIS AND DUNN IN USE ENCOURAGING EXERCISE OF MUSCLES AND CONSEQUENT DEVELOPMENT OF MANDIBLE

tip of tongue over gum to posterior surface of lip, thus producing a temporary tongue-tie.

Postoperative course: No further difficulty in breathing or feeding. No spitting up of food as occurred before operation. In thirteen days after operation the patient had exceeded his birth weight by two ounces (8–10). The Davis and Dunn milk bottle attachment was employed for several months, and the patient's lower jaw grew steadily. On August 20, 1942 the lower incisor teeth were only 0.3 cm. behind upper incisor level.

Case 3. J. E. L. admitted to Vanderbilt Hospital October 13, 1942. White, male, premature infant aged seven weeks. Seven months delivery weighing four pounds eight ounces. The mother's chief complaint on admission was "cuts his breath off and gets blue." Because the patient would not nurse the breast, breast milk was tried in a bottle, but he could only take about a half ounce each two hours, and each feeding was accompanied by paroxysms of difficult breathing. During the four weeks preceding admission the patient had paroxysmal attacka of dyspnoea and cyanosis four to five times daily, as well as at each feeding. These would start with an inspiratory rattle followed by marked retraction of the sternum and cyanosis. The tongue was found rather far back in his throat at these times. Relief was obtained temporarily by pulling the lower jaw outward. He

had had a purulent dacrocystitis since birth, which had been somewhat cleared up by treatment with boric acid irrigations. On admission his weight was only five pounds two ounces.

Diagnosis: Prematurity, micrognathia with severe linguo-epiglottic obstruction associated. It was fully realized that the prognosis was not good on account of his prematurity, malnutrition and severe respiratory symptoms. Nevertheless, operation seemed the only chance for life; therefore, it was decided upon.

Operation October 14, 1942. Under short ether anesthesia the same plastic operation was carried out as on the patient described under case 1. After a stitch had been inserted through the tip of the tongue at one side for traction, the tongue was surgically sutured to the posterior surface of the lip in order to hold it forward permanently by fusion with the lip and gum. The patient had no respiratory difficulty immediately following the operation and was breathing quietly when he left the operating room.

Postoperative course: Ten hours after operation difficulty of breathing was noted, which was not relieved by pushing forward on the jaw or tongue base. Tracheotomy performed under novocain, and a small tube was introduced without difficulty and gave the patient much relief. The patient's course was better following this and in spite of considerable purulent discharge from the tracheotomy tube gained a pound in weight during the next fifteen days. On the nineteenth postoperative day, November 3, 1942, about thirty minutes after the nurse had cleared the tracheotomy tube, the patient was found dead. No one had noticed any unusual symptoms during the day. Since no post mortem was obtained, the cause of the death was not determined.

Case 4. L. J. C. admitted July 6, 1943. Female infant three days old. Normal delivery at term. Difficulty of breathing and cyanosis at birth. Following this was unable to nurse breast properly. When offered bottle was able to take very little.

On admission to the hospital a post-alveolar, complete cleft (palate) was found. The lower jaw was found to be very small and recessive. On inspiration the tongue was found to fall far backward, as though she swallowed it. This would periodically cause her to become cyanotic. Diagnosis: Micrognathism associated with tongue swallowing and respiratory obstruction.

Operation July 10, 1943. Plastic operation. Surgical fixation of tongue to lower lip (operation identical to that described under case 1).

Postoperative course: Patient had no difficulty in breathing or in taking her formula after operation and gained several ounces in weight before discharge.

Case 5. L. F. E., white female aged six weeks admitted November 26, 1945. Normal delivery at term with birth weight of five pounds fifteen ounces. Chief complaint: "Vomiting."

Present illness: At birth it was noted that the child had a complete, post-alveolar cleft (palate). Mother noticed the first time she saw the child that the ribs and sternum retracted when she breathed. During the first sixteen days the child vomited only once a day or once every other day. Since then she had vomited three or four times daily out of eight feedings a day, occasionally vomiting while she was still trying to take feeding. There was moderate cyanosis at time of vomiting. In three days preceding admission child retained only parts of three bottles.

Examination on admission showed marked evidence of dehydration, respiratory distress, and "pinched facies." Mouth showed small, retracted lower jaw and complete, post-alveolar cleft (palate). When the head was held in the vertical position tongue fell back into throat, and respiration became exceedingly obstructed and difficult. Cyanosis became quite evident. Thorax showed marked sternal retraction, which became worse when the patient was in the above position.

Impression: Complete, post-alveolar cleft (palate); micrognathism with linguo-epiglottic obstruction, vomiting, dyspnoea, malnutrition and dehydration associated.

Operation November 30, 1945. Plastic operation on tongue and lip. Intentional surgical

anastomosis or suture of antero-inferior surface of tongue to posterior surface of lower lip (operation identical to that used in cases 1–4 inclusive). Note on anesthesia chart—at end of operation "color good, respiration regular, condition satisfactory."

Postoperative course: Sternal retraction cleared up almost entirely immediately following operation, and baby had no more vomiting and absolutely no more respiratory obstruction or distress, even when intentionally held in the upright position. The weight gain in four weeks was one pound eleven ounces. During this time the Davis and Dunn milk bottle "crutch" attachment was employed at feeding in order to encourage muscular pull on the mandible.

Case 6. P. A. D., white female seven and one half hours old on admission. Normal delivery at term. Immediately following birth obstetrician noticed baby was cyanotic and had difficulty in breathing. It was noted that she could breathe only in the Trendelenberg position due to recession of tongue and secondary occlusion of the glottis. Patient was given oxygen almost continually following birth until brought *to Vanderbilt Hospital* where, before operation, she was placed in an oxygen tent.

Examination on admission showed cyanotic, new-born infant in respiratory distress,

FIG. 6. X-RAYS OF CASE OF DAVIS AND DUNN (SEE TEXT) SHOWING DEVELOPMENT OF MANDIBLE IN 9½ MONTHS THROUGH USE OF THEIR APPARATUS

with small, retracted lower jaw, small, retracted tongue, post-alveolar, complete cleft (palate), inspiratory sternal retraction. Impression: Post-alveolar cleft (palate); micrognathia with associated linguo-epiglottic obstruction of extreme degree.

Operation performed within an hour of admission. Same procedure employed under light ether anesthesia as used in operations on patients 1–6 inclusive; *viz*, permanent surgical suture of tongue to lip.

Postoperative course: The patient's dyspnoea and cyanosis, which were of sufficient severity before operation to necessitate use of an oxygen tent, cleared up immediately following the operation. No more cyanosis was noted in the eighteen days until discharge The patient took fluids well. The only postoperative complication was a slight diarrhea, which cleared up in about three days. The Davis-Dunn milk bottle apparatus was prescribed to aid in the development of the mandible by exercising the jaw muscles.

DISCUSSION OF MICROGNATHIA

Davis and Dunn (1) present a good summary of the literature on micrognathism. It is certain that each year there are many deaths from the dyspnoea

and attendant respiratory complications present in so many of these cases. It is also certain that this has been the case at Vanderbilt Hospital. We agree with these authors in saying that the various appliances described for the relief of this deformity "have the disadvantages of being cumbersome, difficult of retention, insanitary, and requiring a closed mouth." In the cases where dyspnoea is sufficiently severe to cause any alarm, or where feeding is difficult, we feel that the short operation which we have described should be carried out for the purpose of gaining immediate relief from respiratory difficulty. After operation the excellent "lip-guard" apparatus which Davis and Dunn have devised should be employed to produce a lengthening of the jaw through muscular action. From the benefit already evident in our patients' cases we feel certain of the value of their apparatus. Figure 6 presents roentgenograms of Davis and Dunn (1) showing the striking increase in the length of the mandible which resulted from its use over a nine and a half months period on one of their cases.

SUMMARY AND CONCLUSIONS

1. A series of six cases of micrognathia under two months of age is reported.
2. Each case presented the typical symptoms of intermittent attacks of "tongue swallowing," inspiratory obstruction, sternal retraction, dyspnoea, and cyanosis.
3. Anatomically speaking, the mental spines at the posterior border of the symphysis of the mandible are the chief bony attachments of the genioglossi muscles and frenulum of the tongue. In micrognathia these points are placed considerably more posteriorly than normal; therefore, the unsupported tongue presumably falls down over the epiglottis except when it is voluntarily held forward by overexertion of its muscles.
4. From the physiological standpoint, although varying in degree for different cases, the obstruction was shown by laryngoscopic examination to be inspiratory, the tongue acting as a ball valve at the epiglottic level.
5. A plastic operative procedure designed anatomically to correct the retroposition of the tongue is described.
6. This procedure was carried out on all six patients.
7. Five, or 83.3%, have had no further symptoms after operation.
8. In one, a premature infant, the operation gave only temporary relief. Death ensued several days later from other causes, at a time when no obstruction was present.
9. There was no operative fatality.

REFERENCES

(1) Davis, A. D. and Dunn, R.: Am. Jour. Dis. Child., 45: 799 (April) 1933.
(2) New, Gordon B.: J. A. M. A., Vol. 81, No. 5, p. 363 (August 4) 1923.

NASOPHARYNGEAL ATRESIA

With the Report on a New Procedure by Skin Graft to the Lateral Pharyngeal Wall

HAROLD S. VAUGHAN, M.D.

From the Department of Surgery, New York Post Graduate Medical School and Hospital, New York City

Adhesion of the soft palate to the pharyngeal wall may be congenital or acquired. Congential atresia is due to arrested development in the early stage of the embryo. The buccopharyngeal membrane at the anterior end of the foregut may fail to open and disappear, and the pharynx remains separated from the mouth and nasal cavity. J. E. Mackenty gathered reports on several congenital cases in the literature, and reported one of his own. He described a membrane dividing the nasopharynx into an upper and lower chamber. This membrane was thin, easily broken, and showed no tendency to reform.

Acquired malformations are inflammatory, degenerative, and traumatic changes in the wall of the pharynx. The writers of thirty or forty years ago placed great stress on syphilis in relation to nasopharyngeal atresia although improved methods of treatment have largely eliminated this factor.

Wright and Smith mentioned sixty-nine cases of nasopharyngeal atresia, fifty-eight of which were due to syphilis. In addition to trauma, Brophy recognized the etiological association of diseases that effect the mucous membrane of the palate and pharynx, such as syphilis, tuberculosis, diphtheria, scarlet fever, measles and others, all of which may be attended by extensive inflammation, leaving an excoriated surface to favor adhesion of the palate to the pharyngeal wall. He reported having seen five cases, but mentioned the cause in only one, a boy of nine, who developed atresia after the removal of tonsils and adenoids.

In addition to a very complete review of the subject, Mackenty reported ten cases seen over a period of twenty years. The cause in these cases was as follows: syphilis, four; trauma, from removal of tonsils and adenoids, two; congenital arrested development, one; scarlet fever, one; not ascertained, two.

SYMPTOMS

Nasopharyngeal atresia causes a partial or complete stoppage of nasal breathing, depending upon the amount of destruction. Complete occlusion is rare, as a small probe can usually be passed into the epipharynx even though the opening is too small for drainage or the passage of air. The stagnation of secretions may result in intranasal and Eustachian tube infection with impaired hearing. The mucous membrane of the epipharynx assumes a grayish macerated appearance as seen at operation.

PROGNOSIS

In the acquired type the prognosis depends upon the amount of destruction of the mucosa, and the thickness and density of the scar. Dense scar tissue with

limited blood supply is poor material and unsuitable for flaps, especially when the entire pharynx is contracted toward the median line. However,it is always possible to produce and to maintain an open cleft in the soft palate farther forward, and thus correct the nasopharyngeal atresia, although the patient is likely to develop cleft palate speech. The result may be favorable when the binding scar is thin, and the pharyngeal mucous membrane is not very much thickened by scar. The prognosis of nasopharyngeal atresia is also favorable when the adhesions follow simple inflammation or trauma, rather than when due to syphilitic inflammation.

TREATMENT

The problem is to maintain an opening against a pull of scar contraction which begins at the angles of the wound and draws toward the center, even to some extent after the raw surfaces have epithelialized. Mackenty developed an operation by which he folded flaps from the lower end of the palate and adjacent pharyngeal wall against a raw area on the nasal surface of the palate so that the raw surface of the pharyngeal wall could only contact an epithelialized surface on the soft palate. He stated that "if the flap operation is to be successful, it is essential that the mucous membrane on the posterior pharyngeal wall below the normal line of the velum palati should not be entirely destroyed". The principle of the Mackenty operation is shown in the following illustration (fig. 1-A,B,C,). In theory, this plan is excellent for the prevention of raw surface contact, but from a practical standpoint these cases are usually seen after they have undergone two or three operations to incise and dilate the stricture with the result that there is an excessive amount of dense scar, and it may then be difficult or impossible to obtain flaps flexible enough to permit folding.

C. J. Imperatori reported the case of a three and one half year old child operated in 1943 by the Mackenty method. The opening was kept from contracting by weekly, and later monthly, examination to dilate the opening with a Kelly clamp. Six months later, and again two years later, he reported a highly satisfactory result.

It will be seen from a study of the literature that traumatic atresia, following removal of tonsils and adenoids, is relatively uncommon considering the large number of these operations. However, palate and pharyngeal pillar injuries other than nasopharyngeal atresia are somewhat more common. The writer has seen seven cases in four of which cleft palate speech followed removal of tonsils and adenoids, and was due to shortening and fixation of the palate by scar contraction which prevented velopharyngeal closure. The other three were complete nasopharyngeal atresia from union between the soft palate and the pharyngeal wall, and the report on these cases is as follows:

Case 1.—W. S., female, six years of age, seen in February, 1944. Tonsils and adenoids were removed six months previously. The mother reported that the child's throat was very sore following the operation. This was followed by noisy respiration, especially at night, and inability to breathe through the nose. There was also a thin discharge from the nose. Examination showed the soft palate and posterior pillars adherent to the pharyngeal wall

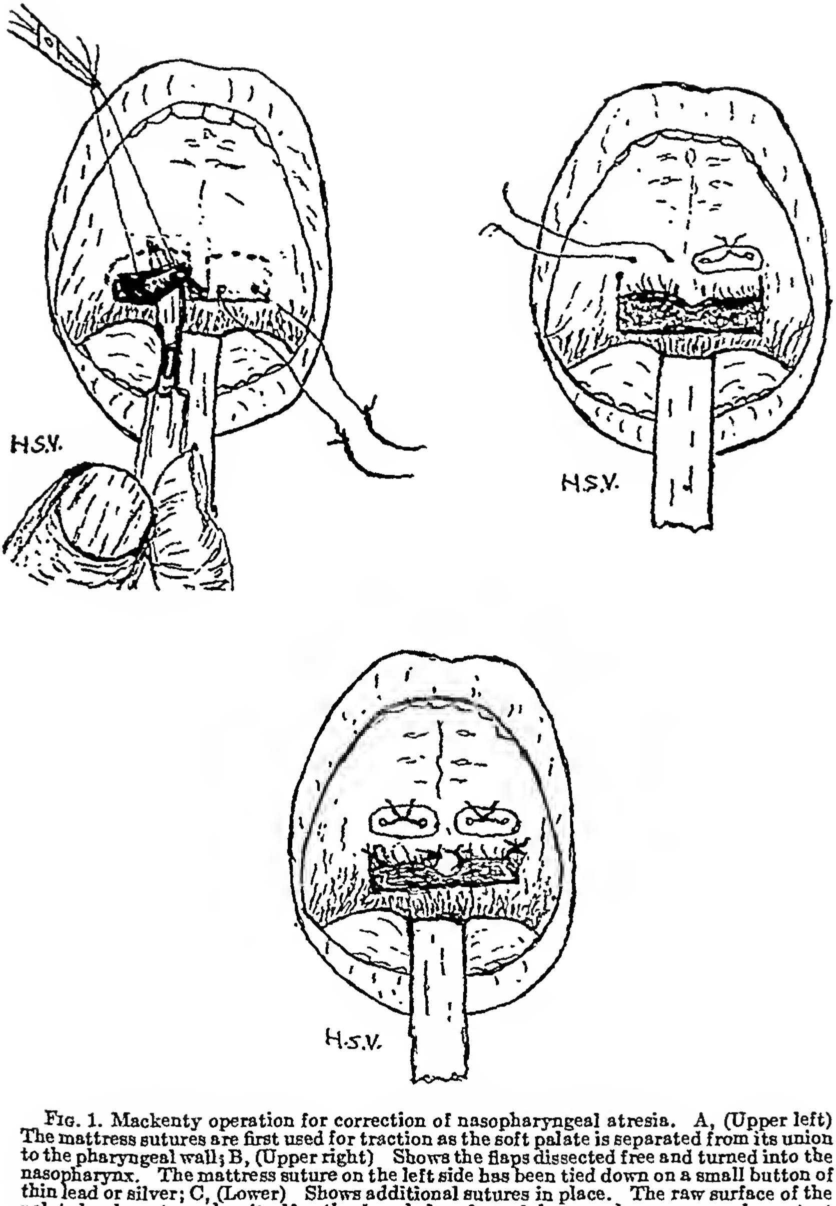


FIG. 1. Mackenty operation for correction of nasopharyngeal atresia. A, (Upper left) The mattress sutures are first used for traction as the soft palate is separated from its union to the pharyngeal wall; B, (Upper right) Shows the flaps dissected free and turned into the nasopharynx. The mattress suture on the left side has been tied down on a small button of thin lead or silver; C, (Lower) Shows additional sutures in place. The raw surface of the palate has been turned on itself so the denuded surface of the nasopharynx can only contact the epithelial surface of the palate.

(fig. 2-A). There was a slight opening behind the uvula that admitted a small lacrymal probe. There was also very little scar tissue in the area of union between the soft palate and pharyngeal wall as no attempt had been made to free the adhesions.

Under ether, the soft palate was dissected from the pharyngeal wall. A small catheter, carrying heavy silk, was passed through each nostril into the pharynx. The silk was picked up and carried out of the mouth. The ends were then tied to 24 gauge silver wires which were attached to a thin silver diaphragm (fig. 2-B), and withdrawn through the nose until the upper edge of the silver diaphragm contacted the posterior end of the vomer (fig. 2-C). A small piece of waterproof adhesive was placed on the upper portion of the lip and base of the columella. The two wires from the nose were then tied down against the columella after sponge rubber had been interposed for protection between the wires and the adhesive covered columella (fig. 2-D). The diaphragm was left in place for four weeks until the raw surfaces had epithelialized. No after-dilation was necessary although there was some contraction of the opening. Examination two years later showed normal breathing, and no further symptoms of atresia.

Case 2.—J. W., male, five years of age, seen in March, 1944. Tonsils and adenoids were removed at two years of age. Owing to continued mouth breathing, the first operation was considered incomplete, and at nearly five years of age he was reoperated for tonsils and adenoids. A few days later, the mother noticed noisy respiration and restless nights with inability to breathe through the nose. The surgeon reported adhesion of the soft palate to the pharyngeal wall, and, at the end of two weeks, operated to relieve the adhesion. This attempt was unsuccessful. After two weeks the operation was repeated, also without success.

Examination by the writer six weeks later showed a poorly nourished child. The oropharynx and posterior part of the soft palate and faucial pillars presented a continuous mass of scar tissue. Nasal breathing was absent.

Treatment.—Owing to the extent of the scar tissue there was some question whether the silver diaphragm would be effective in this case, as more scar contraction could be expected than in Case I. The soft palate was separated from the pharyngeal wall. Incisions were made following the Mackenty technique, but the flap on the right side split and shredded under manipulation, and the flap on the left side was too rigid to permit it to be satisfactorily folded upon itself though it was drawn forward by a mattress suture and tied down on a silver button. The silver diaphragm was inserted as in Case 1, and left in position for four weeks. Three weeks after its removal a reduction in the opening was noted. The mother was given a cone-shaped dilator (fig. 3-A, B), which fitted snugly into the opening, and which she passed daily. Larger sizes were later substituted. Now, two years later, the child is in excellent health and developing rapidly. Breathing became normal immediately after the operation, and has continued so. The nasopharyngeal opening shows no tendency to contract, and is ample in size.

The most important consideration in this operation is to prevent contraction at the lateral pharyngeal angles of the newly separated areas. Skin grafting has been suggested, but rejected, and never tried as far as we can determine because of the difficulty of maintaining immobility of the graft, as there is normally very free movement of the pharyngeal wall in swallowing. We have felt that reduction of the pharyngeal opening would be largely forestalled if the pharyngeal angles of the wound could be prevented from contracting. This surmise has been borne out by the procedure in the following case.

Case 3.—S. M., female, age 68. Past history: negative except for a previous sinus involvement. Present history: tonsils and adenoids removed on March 12, 1946. Following their removal the patient could get some air through the nose on inhalation, but was unable to blow or to exhale through the nose. On three occasions after the tonsillectomy the contractures were incised and spread by the use of a clamp.

Examination on June 10th disclosed the soft palate adherent to the pharyngeal wall. Palpation indicated dense scar tissue along the lateral pharyngeal wall (fig. 4-A). A catheter considerably smaller in diameter than a lead pencil could be passed behind the

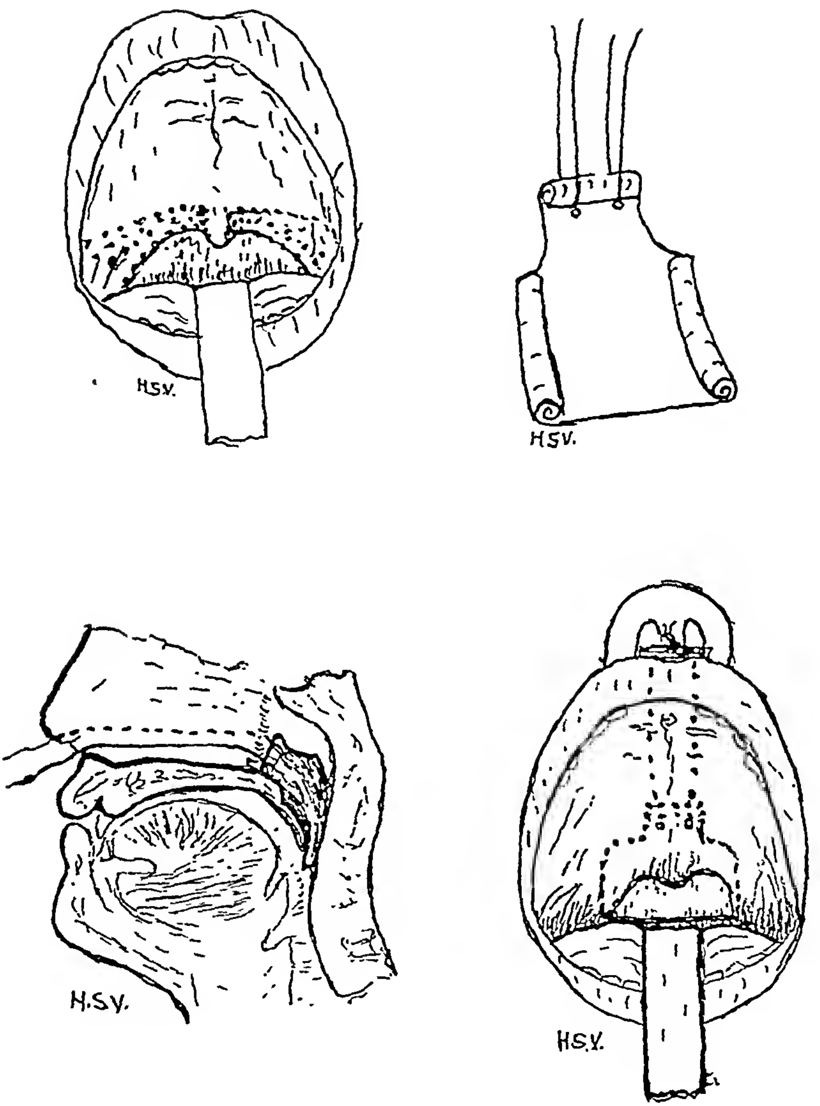


FIG. 2. Author's procedure for Case I, traumatic nasopharyngeal atresia. A, (Upper left) Dotted lines indicate the extent of adhesion between the soft palate and the nasopharynx; B, (Upper right) Shows the silver diaphragm that was inserted between the soft palate and the pharyngeal wall after separation of the scar adhesions; C, (Lower left) Shows the silver diaphragm with retaining wires on each side of nasal septum; D, (Lower Right) Shows the silver diaphragm in position with retaining wires tied down against the nasal columella. Adhesive plaster and soft rubber are interposed for protection.

uvula into the nasopharynx. Nasal breathing was absent, and a bad taste from the throat was the chief complaint.

The patient was admitted to the hospital, and under intratracheal ether anesthesia the soft palate was separated from the lateral and posterior pharyngeal wall. Dense scar tissue was removed, especially on the right side. Flaps on each side of the uvula were too dense to be folded over, but were drawn away from contact with the pharyngeal wall by mattress sutures which emerged through the palate at the junction of the hard and soft palates, and were then tied down on silver buttons for support (fig. 4-B). Two pieces of rubber tubing about one inch long were then covered with Thiersch grafts which were sutured to the tube with the raw surface outside. A mattress suture was then secured to each end of the graft-covered tubes, and the latter were passed along the lateral pharyngeal wall under the soft palate. The graft-covered tubes were firmly sutured, one on each side, to the pharyngeal wall. The ends of the mattress sutures were tied down on silver buttons to hold them firmly in place (fig. 4-C). A silver diaphragm was then passed behind the soft palate as described in case 1 (figs. 2-B, C, D). The width of the diaphragm was made to correspond to the distance between the skin covered tubes (fig. 4-D). The tubes were removed at the end of two weeks disclosing a skin lining of the angles of the nasopharyngeal opening. The silver

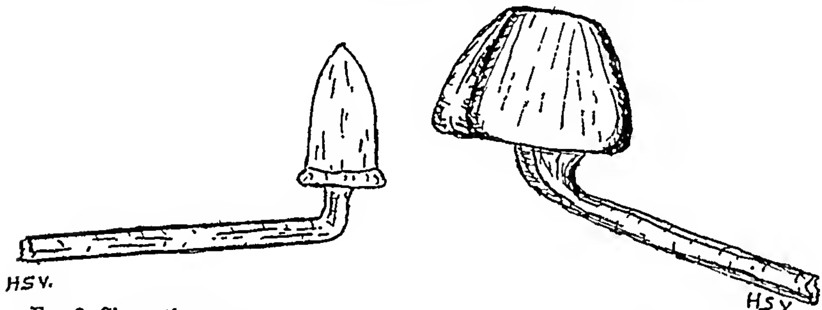


FIG. 3. Shows the types of metal dilator used to maintain the nasopharyngeal opening until there is no tendency to contract.

diaphragm was removed at the end of the third week. An instrument was made that accurately fits the opening, and the patient passes this instrument behind the soft palate daily to prevent contraction.

SUMMARY

The writer recognizes the impropriety of dogmatic statements on a limited number of cases, but no one has reported many operations for this condition. The Mackenty procedure for nasopharyngeal atresia is an excellent method when there is a minimum of scar tissue, but it is difficult or impossible to obtain folding flaps from the dense scar encountered. Simple cases with very little heavy scar can be fully relieved by the interposition of a silver diaphragm which is left for four weeks.

From the experience gained in case 3, it would seem that skin grafting the opened palatopharyngeal area offers the best chance to maintain an adequate nasopharyngeal passage. All cases should be observed for some time following operation to determine whether there is any tendency for the opening to contract, and to use the dilator if necessary.

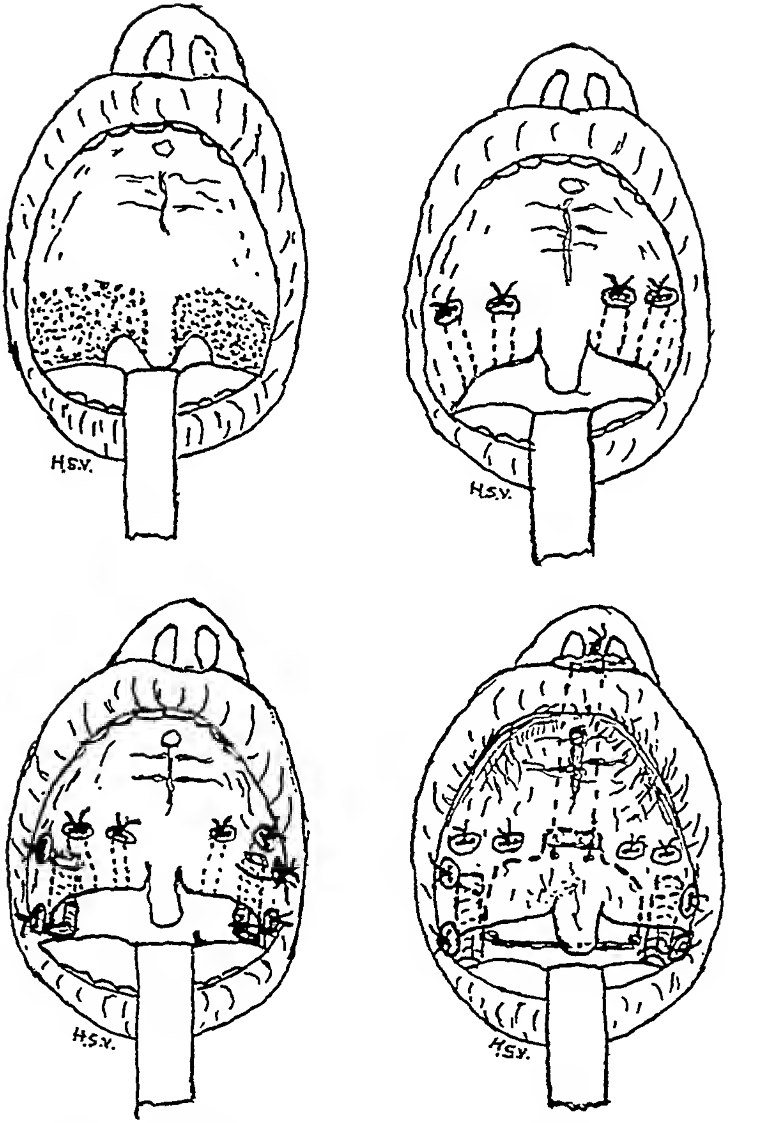


FIG. 4. Diagrammatic sketches to show the extent of atresia and the procedure for correction in Case III. A, (Upper left) Dotted area indicates the extent of palatopharyngeal adhesion; B, (Upper right) Shows the palate separated from the pharyngeal wall. The thickened edges have been turned back with mattress sutures and tied down on silver buttons; C, (Lower left) Shows the rubber tubes which are covered with Thiersch grafts and sutured firmly to the lateral pharyngeal wall; D, (Lower right) Shows the silver diaphragm in position between the skin covered tubes.

BIBLIOGRAPHY

BAILEY, FRED W.: Occlusion of the Naso-pharynx. J. Iowa, M. Soc., 7:57 (Feb.) 1917.

BALLENGER, WILLIAM LINCOLN: Diseases of the Nose, Throat and Ear. 5th ed., Philadelphia, Lea and Febiger, p. 370, 1925.

BROPHY, TRUMAN W.: Cleft Lip and Palate. Philadelphia, P. Blakiston's Son & Co., p. 260–263, 1923.

HALL, F. J. VINCENT: Adhesion of Soft Palate to Nasopharynx. Brit. M. J., 1: 18, 1909.

IMPERATORI, CHARLES J.: Atresia of the Pharynx Operated upon by the Mackenty Method. Ann. Oto., Rhin. and Laryn., no. 2, 53: 329 (June) 1944.

ISAACS, HARRY E.: Stenosis of the Naso-pharynx Operation with Prosthesis. Laryngoscope, 27: 885 (Dec.) 1917.

MACKENTY, JOHN EDMUND: Nasopharyngeal Atresia. Arch. of Oto., 6: 1–27 (July) 1927.

PADGETT, EARL CALVIN: Surgical Diseases of the Mouth and Jaws. Philadelphia and London, W. B. Saunders Co., p. 268, 1938.

PARKER, CHARLES A.: A Guide to Diseases of the Nose and Throat and Their Treatment. New York, Longmans, Green and Co., p. 161–162, 1906.

WRIGHT, JONATHAN, AND SMITH, HARMON: Diseases of the Nose and Throat. Philadelphia, Lea and Febiger, p. 648–652, 1914.

PLASMA FIXATION OF SKIN GRAFTS

Critical Analysis of Technic

J. EASTMAN SHEEHAN, M.D.

New York

Continued satisfactory experience with the plasma fixation of skin grafts suggests that much of the criticism directed against this method is based on misapprehension and faulty technic. This paper will analyze the procedure in the light of adverse comments. A case of naevus pilosus illustrates the text (fig. 1).

PREPARATION OF DERMATOME

A light coating of rubber cement (Preferably Goodrich No. 4 Rubber Cement or U.S. Rubber Patch Cement; their transparent color allows the graft to be seen through the tulle) is applied to the drum of the dermatome, which is then rolled upon a sheet of previously washed, stretched and pressed tulle; the latter must overlap the drum about an inch in all directions. When the cement has dried, an additional thin coat is applied to the tulle, saturating it. This also must be allowd to dry thoroughly. The tulle overlap is pasted down over the sides of the drum and the latter is placed in an autoclave, at 20 pounds' pressure and a temperature of 240° F., for 34 minutes. This sterilizes the drum and vulcanizes the rubber.

Unless this procedure is followed without deviation, there may be subsequent difficulty in securing adherence of the graft to the tulle. Boiling is inadmissible as it causes the cement to dissolve.

PREPARATION OF PLASMA AND WHITE-CELL EXTRACT

Five cc. of the patient's blood is withdrawn into a syringe containing 1 mg. of heparin and 1.5 cc. of Tyrode's solution (1). The resulting admixture is centrifuged for 25 minutes, at the end of which time the red blood cells are at the bottom with the white cells above them and the plasma at the top. The plasma is drawn off into one tube; the white cells are transferred to another containing 1.5 cc. of Tyrode's solution and a few small glass beads. Both tubes are set in cool water.

TAKING AND PLACEMENT OF GRAFT

The area of excision is outlined and the surrounding skin is marked at intervals to aid in subsequent placement of the graft. Following excision, a pattern of the defect is made in lint, which serves the additional purpose of absorbing any ooze. Markings corresponding to those at the edges of the defect are made on the pattern, which is then outlined on the donor site, the guide marks being reproduced on the graft. After cleansing of the circumscribed area, it is coated with rubber cement; the adjacent skin is powdered with parloidan and sul-

fadiazine. If the boundaries of the graft are superficially incised, a slight gaping results which facilitates accurate cutting to pattern (fig. 2).

The adhesive quality of the sterilized drum is tested; if dry, it is recoated with a thin solution of rubber cement. The dermatome is set with the surface of the tulle at zero. If desired, a mirror, which has been fully described else-

FIG. 1 PORT-WINE STAIN (NAEVUS VINOSUS)

FIG. 2

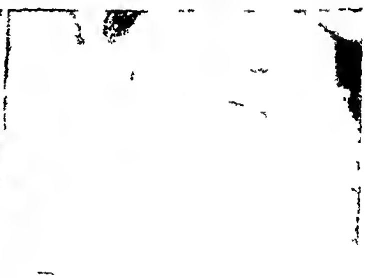


FIG. 3

FIG. 2. REMOVAL OF OUTLINED GRAFT FROM RIGHT THIGH
FIG. 3. RAW AREA AFTER REMOVAL OF GRAFT

where (1), can be attached. Bried preliminary pressure is exerted to test the adherence of the surfaces and the graft is cut, cleaving to the tulle on the drum (figs. 3 and 4). The tulle, with the graft attached, is then removed from the drum (fig. 5).

After thorough cleansing and drying, the recipient area receives a light application of a sulfonamide, penicillin or gramicidin, while the neighboring skin

is coated with rubber cement. The defect is thinly painted with plasma; the white-cell extract, to which propamadine or sulfadiazine may be added, is applied to the raw surface of the graft.

Some surgeons hold that this is unnecessary as the raw areas furnish their own plasma in sufficient quantity for fixation of the graft. In my experience it is the exceptional case in which the serum produced in the wound is adequate to produce as rapid fixation as when additional plasma is applied. The time

FIG. 4. GRAFT ON DRUM

FIG. 5 FIG. 6

FIG. 5. GRAFT ON TULLE
FIG. 6. APPLICATION OF GRAFT ON TULLE TO DEFECT

factor is particularly important when the tulle is employed without suturing: rapid fixation is essential.

The use of thrombin, which also has advocates, is more hazardous. If too much is applied, even a slight ooze after application of the graft may result in a clot, causing the death of that portion of the graft. In one group of cases thrombin, plasma and fibrinogen were used experimentally (2)(3), but the results were not as good as when the plasma and white-cell extract were employed alone.

Taking one of the markings as a key, the surgeon applies the graft to the defect, using both hands to achieve exact approximation to the edges and adherence of the overlapping tulle to the cement-coated surrounding skin (fig. 6). The graft is then rolled in place and pressed lightly with damp cotton to eliminate air pockets and ensure apposition of the raw surfaces. Rubber gloves must be removed before the graft is applied to the defect as they stick to the rubberized tulle.

The advantages of the latter are manifold. Besides permitting easy handling of the graft without mutilation, it militates against contraction. Should this occur, the rubberized fabric can easily be stretched.

Pressure dressings are applied to reduce oedema, prevent air pockets and bleb formation, and assure complete immobilization. Pressure is a valuable aid to

FIG. 7. END RESULT

healing in all wounds. It is particularly necessary in skin grafts, where there is more risk of infection.

Dressings are changed five days after operation. Some surgeons have complained of difficulty in removing the rubberized tulle. This can be overcome by the application of sulfuric ether and patient, painstaking handling (fig. 7).

CONCLUSIONS

1. The application of plasma to the recipient area and white-cell extract to the under surface of the transplant materially hastens the fixation of skin grafts. The grafted tissues return to their original color more quickly and sometimes take on the color of the surrounding skin.

2. This method leaves a linear scar which is far more desirable than a suture line.

3. The ease of application of the graft and the omission of suturing materially

shorten the time of operation so that more cases can be done in a given period than by other methods.

4. Personal experience demonstrates this technic to yield uniformly good results in large defects (the length of an arm or leg, almost the entire side of a face, half an abdomen, etc.) as well as small ones.

5. It is essential to the success of this method, as of any other, that strict asepsis be maintained, that the rules applicable to all skin grafting be scrupulously observed, and that every effort be made to keep the patient's general condition at optimum.

6. Good teamwork between the surgeon and his assistants is an important factor in success. Each member of the team must understand the nature and timing of his duties.

REFERENCES

(1) Sheehan, J. Eastman: General and Plastic Surgery. Paul B. Hoeber, Inc., New York, 1945, pp. 250–254.
Application of Epidermic Skin and Mucous Membrane to Congenital and Acquired States. M. Rec., 152: 404, 1940.
Plasma Fixation of Skin Grafts. Am. J. Surg., 65: 74, 1944.
Plasma Fixation of Skin Grafts. Lancet, London, 2: 363, 1944.
(2) Sheehan, J. Eastman: Further Notes on the Plasma Fixation of Skin Grafts. Lancet, 1: Feb. 1945.
(3) Jenney: Am. J. Surg., Vol. LXVII, Jan. 1945.

THE EFFECT OF PENICILLIN AND STREPTOMYCIN APPLIED LOCALLY ON THE TAKE OF SKIN GRAFTS*

HAMILTON BAXTER, M.D.

Department of Plastic Surgery, Royal Victoria Hospital and McGill University, Montreal, Que.

INTRODUCTION

Although much has been written about the use of penicillin in surgery, little attention has been devoted to its use as an aid in skin grafting procedures and no report on the similar use of streptomycin has been found to date. Hirshfeld and co-workers (1) have claimed that the percentage of takes of skin grafts in seventeen patients was improved following the use of hourly intra-muscular injections of penicillin for a number of days before and after operation. Lam and McClure (2) also used intra-muscular penicillin in seven cases. However, in one instance gauze packs soaked in penicillin solution containing 100 units per cc. were applied daily to the skin grafts. Rawles (3) has reported the use of penicillin dressings on granulating areas with favorable results, both before and after skin grafting. The frequent application of antibiotics to granulating areas *prior* to skin grafting is not without disadvantages. It has been demonstrated by Miller and Bohnhoff (4) that repeated cultivation of certain cocci on media containing increasing concentrations of penicillin or streptomycin enhanced their resistance to both, particularly the latter. The development of penicillin or streptomycin resistant organisms or sensitization of the patient to these antibiotics before skin grafting would be detrimental to the subsequent effect of these substances.

A patient with extensive third degree burns is in a precarious condition. Early skin grafting is most important to relieve suffering, shorten convalescence and prevent deformity. This process may be speeded by surgical debridement. As Padgett (5) and others have shown, the major reason for the failure of early skin grafting has been the infection which frequently developed beneath the graft and resulted in its partial or total loss. He has reported that in one-third of his skin grafting operations on granulating wounds, twenty-one per cent or more of the graft was lost. Other factors such as insufficient or uneven pressure on the graft, anaemia, hypoproteinemia or hypovitaminosis may be controlled by appropriate measures. For general supportive therapy, frequent blood transfusions, high protein diet, amino acids intravenously and adequate vitamins should be given if necessary. In addition to the presence of streptococci and staphylococci, granulating wounds frequently become infected with B. pyocyaneus, B. proteus and B. coli and other organisms. While sulphonamides control many streptococcal infections, they are often ineffective against staphylococci, B. pyocyaneus, B. proteus and B. coli.

* This investigation was supported by means of a grant from the National Research Council of Canada.

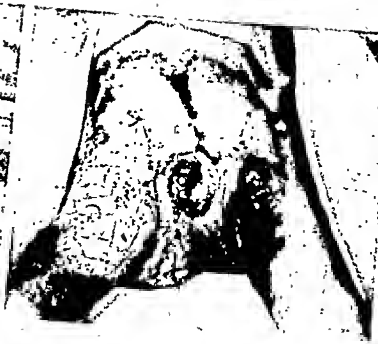
Penicillin is a most potent antibiotic as far as gram positive organisms are concerned and streptomycin is most effective against gram negative organisms. The former reacts as an organic acid while the latter reacts as an organic base. Penicillin is more effective against streptococci and staphylococci. However, it is destroyed by acids, alkalies, certain heavy metals, alcohol, heat and penicillinase, an enzyme found in some bacteria, e.g., B. pyocyaneus, B. coli, B. paracolon, aerobacter aerogenes and alcaligenes fecalis. On the other hand, streptomycin while reacting less powerfully against streptococci and staphylococci than penicillin is very active against the gram negative organisms, B. pyocyaneus, B. proteus and B. coli, which often cause the loss of skin grafts.

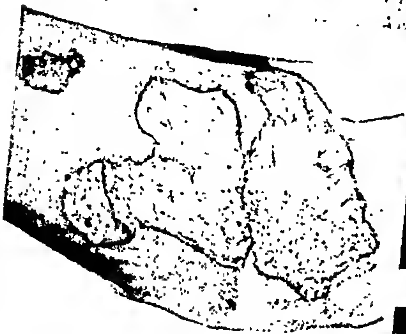
Penicillin and streptomycin have numerous advantages over the sulphonamides. They have a more powerful therapeutic effect, their action is little affected by the number of bacteria present and they are effective in the presence of pus, peptones, tissue debris and other sulphonamide inhibiting substances. They are essentially non-toxic in therapeutic doses and sensitization is rare. They may be effective against organisms which have become sulphonamide resistant. No other drug administered systemically is known to interfere with the local action of penicillin or streptomycin. In the administration of these substances certain general principles should be observed. The infecting organisms must be sensitive to the antibiotics and they must be able to reach the bacteria. All necrotic tissue should be removed and an adequate dose of the antibiotic used. The patient must be given adequate nutritive support. As previously mentioned, organisms may develop resistance to penicillin or streptomycin if local applications are employed for too long a period prior to skin grafting. It has been noted since the beginning of this investigation that strains with high penicillin or streptomycin resistance are being encountered frequently and this is probably evidence of indiscriminate use of these substances before definitive treatment is carried out. It is felt that application of the antibiotics at the time of skin grafting and subsequently, if necessary when the dressings are changed, constitute the most satisfactory procedure. (Figs. 1, 2, 3, 4.)

METHODS

Some months ago we started to investigate the influence of penicillin and streptomycin applied locally on the take of skin grafts. Dermatome skin grafts of varying thickness were used on 44 patients in 50 separate procedures. The recipient areas in every case were contaminated, granulating wounds due mainly to burns but, in some instances, were caused by trauma, varicose ulcers and so on (table 1). Cultures of the area were taken before operation and afterwards if any infection causing loss of the graft was present. Skin grafting was performed as soon as the necrotic tissue could be removed and the patient was in condition for operation. Frequently, necrotic debris was excised and the skin graft applied at the same operation. In some instances skin grafting was delayed because the patient, usually a military casualty, had been burned in a distant theatre of operations and was not transferred for some time. Some of these men who had lost from 40 to 50 pounds were in poor condition for operation and it was neces-

1





2

3

4

FIG. 1. Mixture of penicillin and streptomycin being injected under the skin graft prior to application of a pressure dressing. (This mixture is now used routinely beneath skin grafts placed on infected granulating areas.) Staphylococcus pyogenes and B. Coli were present pre-operatively. The opposite side served as the control area.

(a) Seven days after grafting, the control area on the patient's right side showed numerous pustular areas and treated area none.

FIG. 2. Large granulating area on thigh. Staphylococcus pyogenes and micrococci were found pre-operatively. Photograph eight days postoperatively showed infected areas in the centre and about the periphery of the [illegible] the distal half of the graft which was treat[illegible] [illegible], while

FIG. 3. Staphylococcus pyogenes and s[illegible] [illegible] A' were present pre-operatively. The proxim[illegible] [illegible] infection served as the control. Photograph six [illegible]ys postoperatively.

FIG. 4. Extensive loss of proximal half of skin graft on arm. Seven days after skin grafting. Penicillin and streptomycin mixture injected under distal half of graft. Pre-operative culture showed staphylococcus pyogenes and streptococcus pyogenes, Lancefield group 'A'.

sary to improve their general condition before skin grafting could be undertaken safely. A patient who has survived burn shock should not run the risk of death from too early or too extensive a skin grafting procedure. While it is important to graft early to control sepsis, loss of plasma, and shorten hospitalization, it should not be forgotten that patchy takes with poor cosmetic results are most undesirable from the view point of both the patient and the plastic surgeon.

In comparing the effect of antibiotics on the take of skin grafts in different patients, certain experimental difficulties are encountered. The number and variety of bacteria present in the granulating wound, the state of nutrition of the patient, the site of the wound, the thickness of the skin graft and the amount of pressure exerted by the dressing all contribute to the final result obtained. To control these variables as much as possible we resorted to the following procedure—the same patient was used in comparing the effect of antibiotics on the take of skin grafts. The granulating wound was divided into two parts and sodium penicillin, streptomycin hydrochloride, or both combined were applied to one-half of the area grafted. The solution was prevented from spreading to the control part by a row of fine sutures and by choosing the most dependent half of the granulating area for treatment with penicillin. In these experiments the

TABLE 1

Type of recipient areas on which skin was grafted

BURNS	WOUNDS DUE TO TRAUMA	WOUNDS DUE TO PEDICLE FLAPS	CHRONIC ULCERS	CHRONIC OSTEOMYELITIS OF BONE	MISCELLANEOUS
18	14	7	4	3	4

antibiotics were dissolved in saline or plasma. Concentrations varying from 250 units per cc. to the dry penicillin powder were applied. While the strongest concentration did not injure the skin grafts, the maximum benefit seemed to be obtained by solutions containing from 10,000 to 25,000 units per cc. Just before the pressure dressing was applied, and after all blood clots had been expressed, the solution was injected under the skin graft and under the overlapping edges by inserting a fine, blunt needle through the perforations of the graft. Enough was used to flood the area and exude through the perforations. In some cases a layer of fine mesh gauze soaked in the antibiotic solution was applied to the graft before the layer of xeroform gauze. A pressure dressing was then adjusted in the usual manner. The effect of the addition of thrombin in a concentration of 500 units per cc. to the penicillin solution has been tried. The usual hemostatic effect of thrombin was observed and the activity of the penicillin was apparently not appreciably affected. In a series of experiments it was found that a solution of penicillin containing 5,000 units per cc. placed on an infected granulating area under a small glass cup maintained its activity for at least 48 hours. Since it has been shown that skin grafts start to develop capillary anastomoses in 48 hours, and adequate circulation in 96 hours, *it would appear that the bacteriostatic action of the penicillin is of value in protecting the graft from infection during the*

period when its vitality is low. It was also found that the antibiotic solution in the fine mesh gauze which was used to cover the graft before applying the layer of xeroform gauze maintained its activity for three days. The antibiotic solution which has been most consistently successful, and which we now use routinely, is a mixture of sodium penicillin and streptomycin hydrochloride in a concentration of 25,000 units of each per cc.[1] It is considered that the stronger concentrations are desirable because a more powerful bacteriostatic or bactericidal effect is obtained. This is important when preliminary cultures of the wound show the presence of streptomycin or penicillin resistant organisms. Furthermore, the amount of solution which is necessary to inject under the graft to obtain an adequate concentration of the antibiotic is reduced. The pH of the above solution diluted with an equal amount of fresh plasma has been determined by the hydrogen ion electrode method. It has been found to be pH 7.10 and this explains why no case has been encountered where failure of the graft to take could be attributed to the antibiotic solution.

DISCUSSION

In this series of patients, the following conclusions were reached. Earlier skin grafting is possible on contaminated wounds when a mixture of penicillin and streptomycin is used and a higher percentage take of the grafts is obtained. It is desirable to obtain a pre-operative culture of the granulating area and if possible a test for penicillin and streptomycin sensitivity of the organisms. However, in many hospitals facilities for such studies are not available and the routine use of streptomycin insures that if they are sensitive penicillinase secreting organisms will be controlled as well as certain gram negative bacteria which are commonly found on granulating areas. A solution containing 20,000 to 25,000 units per cc. has been used with satisfactory results. A mixture of penicillin and streptomycin powder has been dusted under skin grafts without interfering with the take of the grafts. Similarly, powdered penicillin and penicillin ointment have not delayed the healing of dermatome donor areas. Penicillin and streptomycin solution may be applied to a grossly contaminated, granulating wound for a day before operation as a wet dressing if it is considered advisable in certain cases, but the danger of developing *resistant organisms* must be considered. We prefer to apply fine mesh gauze soaked in antibiotic solution to the grafts when the dressing is changed for the first time and subsequently, if necessary. The use of antibiotics is especially helpful when skin grafts are applied in the vicinity of the body orifices, in cavities and about the axillae, hands and feet, which are noted for the number and variety of organisms present. We believe that the employment of penicillin and streptomycin *topically* instead of intra-muscularly, orally or by other routes, offers the obvious advantage of enormous concentration of the agent at the site of the skin graft as well as freedom from painful injections and loss of sleep.

As may be seen from table 2, which contains data from twelve consecutive

[1] It should be noted that there is no comparable relation between the penicillin and streptomycin units.

TABLE 2

Results of grafts with and without local penicillin and streptomycin

CASE NO	AGE	SEX	SITE OF GRAFT	THICKNESS OF GRAFT IN INCHES	PRE-OPERATIVE CULTURE	POST-OPERATIVE CULTURE		PER CENT TAKE OF GRAFT	
						Control area	Treated area	Control half	Antibiotic treated half
1	28	M	Arm	0.016	Staph. pyogenes, proteus interm. Diphtheroids, micrococci	—	Healing	90	100
2	30	M	Head	0.014	Staph. pyogenes. Enterococci . Corynebacteria (non-pathogenic)	—	Healing	95	100
3	21	M	Arm	0.014	Staph. pyogenes Diphtheroids	Staph. pyogenes	Healing A few Staph. pyogenes	80	95
4	21	F	Head	0.014	Staph. pyogenes Microcci	Healing	Healing	100	100
5	7	M	Abdomen	0 014	Staph. pyogenes Esch. Coli	Staph. pyogenes P. Morgani Esch. Coli	Staph. pyog. Diphtheroids	90	100
6	46	M	Leg	0.016	Ps. Aeruginosa Diphtherods	—	Healing	90	100
7	24	M	Arm	0.016	Staph. pyogenes. Strep. pyogenes (Lancefield gr. A)	Staph. pyogenes	Healing	90	100
8	54	F	Thigh	0.014	Staph. pyogenes Micrococci	Staph. pyogenes	Healing	85	100
9	42	M	Arm	0.018	Achromobacters Diphtheroids	Healing	Healing	100	100
10	4	M	Arm	0.012	Ps. Aeruginosa Staph. pyogenes	Healing	Healing	100	100
11	56	F	Leg	0.014	Aerobacters Micrococci	Aerobacters Enterococci Strep. (indiff.)	Healing	85	98
12	43	M	Leg	0.016	Staph. pyogenes Esch. Coli	Staph. pyogenes	Healing Few Staph. pyogenes	85	95

patients, in some cases the control areas 'took' as well as the treated areas. In the others there was a difference of from five to fifteen per cent between the control and treated areas. In a few cases when only penicillin was used, most of the skin graft on the control area was lost. One reason for the rather high percentage 'take' of most of the control areas as compared with the figures quoted by Padgett (5) is that exceptional care was taken in preparing cases for operation. In spite of this, there was a definite difference in results.[2]

In conclusion, I wish to emphasize that penicillin and streptomycin are merely helpful adjuncts to successful skin grafting. In these patients blood transfusions, high protein diet and adequate vitamins were provided. The presence of bacteria in a wound does not necessarily mean that a skin graft will be damaged. They must be pathogenic, sufficiently virulent and present in adequate numbers before they can tip the biological scales downward and cause the loss of part or all of the skin graft. To be of any value the antibiotic used must be active against the organism, must be able to reach the bacteria and must be present in sufficient amounts. Viewed in such a way they deserve to be included in the armamentorium of the surgeon who wishes to obtain the utmost success in skin grafting.

I wish to thank Dr. Frederick Smith of the Department of Bacteriology of McGill University for his helpful advice during the course of this investigation.

BIBLIOGRAPHY

1. Hirshfeld, J. W., Pilling, M. A., Briggs, S. W., and Abbott, W. E.; Penicillin and skin grafting. J. A. M. A., 125: 1017–1019, 1944.
2. Lam, C. R., and McClure, R. D.: Penicillin as an adjunct in skin grafting of severe burns. Proc. Am. Federation Clin. Research, 1: 56, 1944.
3. Rawles, B. W.: A routine for early skin grafting of deep burns. Surgery, 18: 696–706, 1945.
4. Miller, C. P., and Bohnhoff, M.: Streptomycin resistant cocci. J. A. M. A., 130: 485–488, 1946.
5. Padgett, E. C.: Skin grafting. Charles C. Thomas, Springfield, Ill., 1942.

[2] As a result of these experiments it is suggested that fine mesh gauze covered with ointment containing penicillin and streptomycin would be of value in the treatment of fresh burns.

A METHOD OF CORRECTING ATRESIA OF THE EAR CANAL

W. H. STEFFENSEN, M.D.

Grand Rapids, Michigan

The following method for correcting atresia of the ear canal has been used by the author successfully in four cases of cicatricial atresia of the ear canal and in one case of congenital webbing of the canal where it was determined preoperatively that the canal was normal medial to the web.

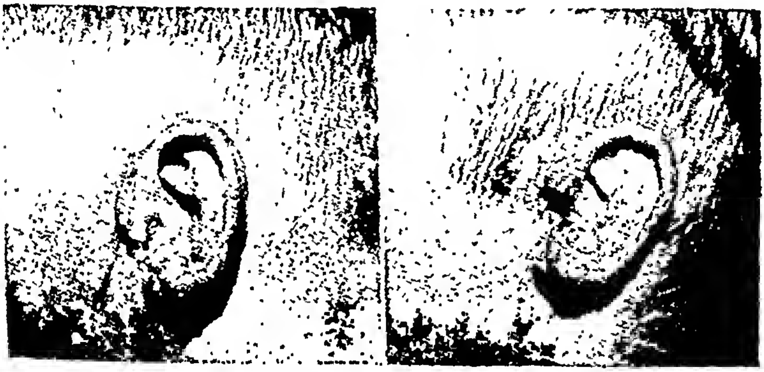


Fig. 1. (a) (Left) Before (b) (Right) After. Cicatricial atresia of the canal following severe laceration of the ear.

Fig. 2. (a) (Left) Before (b) (Right) After. Cicatrical atresia of the canal.

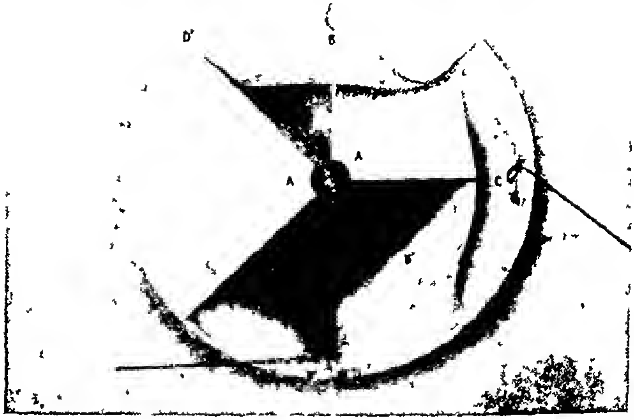


FIG 3 Schematic presentation of atresia The lateral skin surface of the membrane has been incised to create quadrants These are dissected free by the use of a small right angled knife aided by the use of a dura hook These flaps must be freely undermined to establish mobility at their bases

Four similar flaps are created on the medial surface of the membrane The incisions are offset forty five degrees so the flaps thus formed can interdigitate with those of the external surface Sometimes the flaps must be trimmed or thinned to fit in the interdigitated positions, particularly if the scar is dense and little contraction occurs

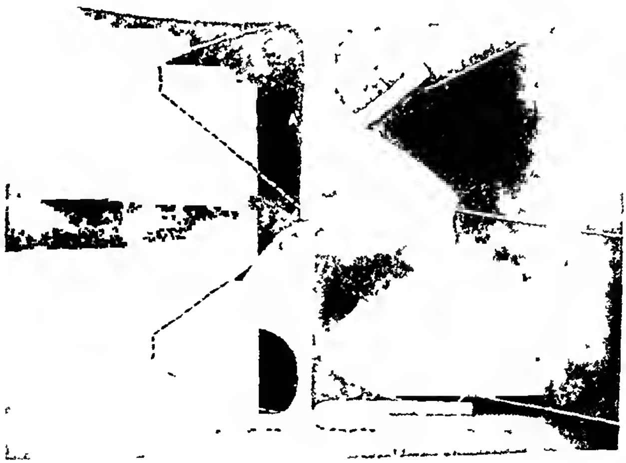


FIG 4 Schematic drawing of sagittal view of flaps

The principle involved is not new It is merely the application of the "Z Plastic" technique to this particular problem The only requirement is a small,

sharp right-angled knife in addition to the regular operating armamentarium. (fig. 1); (fig. 2); (fig. 3); (fig. 4); (fig. 5); (fig. 6).

FIG. 5 The flaps are folded into their interdigitated positions and held in position with light packing—changed as necessary until healing has occurred

FIG. 6. Congenital membrane with small central opening. The canal was normal medial to the web and a normal ear drum was found at operation

A serviceable ear canal was obtained in each of the cases done by this method. The procedure, where feasible, has been more satisfactory and much simpler than excision of the obstructing scar or web and replacement by a skin graft. It presents technical difficulties which characterize "key hole" surgery but it is another useful application of a sound principle in reconstructive surgery.

A METHOD OF PLASTIC RECONSTRUCTION OF THE AURICLE—PRELIMINARY REPORT[1]

JOHN F. FORD, M.D.

New York

One of the most difficult tasks which has confronted the plastic surgeon has been the total reconstruction of the external ear.

The auricle presents a master-piece of fine architecture. It is thin, strong and pliable, and has its characteristic coloring. The external surface presents almost every kind of an angle and curve. The elastic cartilage framework possesses the quality of a spring, so that after the ear is pressed inward or is drawn outward, there is a quick rebound to its original position.

The early work in ear reconstruction was often disappointing. Some surgeons despaired and gave up in desperation, feeling that the deformity which resulted from the congenital absence of the external ear was less of a disfigurement than a surgical monstrosity which sometimes followed reconstruction.

During the last ten years, much progress has been made and it is now possible to do a partial or complete reconstruction of the auricle, which is not at too great a variance from the normal ear. The finished product is usually acceptable to the patient and it is not so obvious that it attracts attention and causes comment from the patient's neighbors.

There were two great problems to solve in the reconstruction of the external ear; (1) To build a framework which would approach the qualities of elastic ear cartilage and, (2) Provide an epithelial covering of the ear which would be similar in color and texture to the ear skin.

Time of Operation. For psychological reasons, the ear should be finished before the child starts to school. It would seem that a congenital absence of the auricle in a girl would not be a major concern, for the reason that the defect could be covered with the hair. This, however, is not the case. A large proportion of girls are quite as concerned, or even more emotionally depressed, than boys as a result of this anomaly. There is a constant feeling of incompleteness of body, and they live in constant anxiety that their friends and associates will discover the defects.

The operation described herein is limited to those cases which have a unilateral microtia or a unilateral absence of the external ear.

CASE REPORT

V. F., age 24, white, male, single, has just been discharged from the U. S. Army. Past History: The patient had a congenital absence of the right auricle, auditory canal, tympanum and ossicles. X-Ray examination showed an absence of the bony canal of the ear.

As a child he remained in the hospital for three years, during which time he underwent many operations for the reconstruction of the auricle. The only result accomplished from

---

[1] From the Departments of Plastic Surgery of the Methodist Hospital, Brooklyn; Flower & Fifth Avenue Hospitals, and Metropolitan Hospital, New York.

these operations was a small pedicle of skin and fat transferred to the region of the ear from the right arm.

Operation: Left (normal) ear—Elliptical-shaped pieces of skin and cartilage were removed from the posterior auricular region in the same manner one performs a lop ear operation. Figs. 1 and 2.

A wedge-shaped excision of ear substance was removed from the left ear and the skin and cartilage edges were closed.

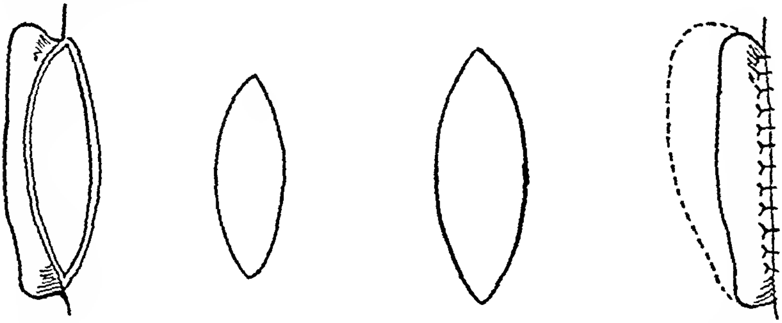


FIG. 1 FIG 1a FIG 1b FIG 2

FIG. 1. DRAWING WHICH SHOWS THE PROJECTION OF THE NORMAL EXTERNAL EAR FROM THE HEAD AND ELLIPTICAL-SHAPED LINES OF EXCISION OF SKIN AND CARTILAGE FROM THE POSTERIOR AURICULAR REGION

(a) Excised cartilage, (b) Excised skin

FIG. 2. SAME AS DRAWING 1, AFTER EXCISION AND CLOSURE, SHOWING THE EAR SET CLOSER TO THE HEAD

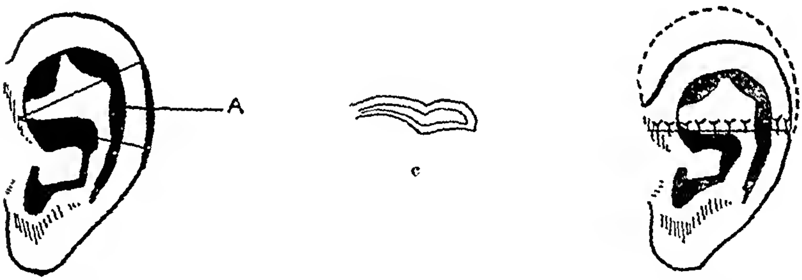


FIG. 3 FIG. 4

FIG. 3. OUTLINE OF WEDGE-SHAPED EXCISION OF EAR SUBSTANCE FROM THE NORMAL EAR

(c) Cross section of the wedge-shaped excision as shown in 3.

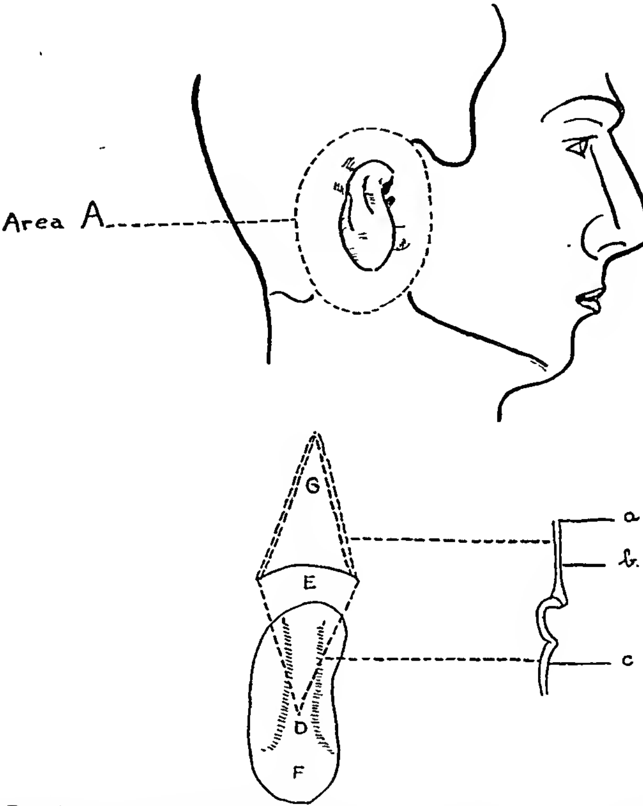
FIG. 4. SAME EAR AS FIG. 3 AFTER CLOSURE, SHOWING THE POSTOPERATIVE REDUCTION IN SIZE OF THE NORMAL EAR

The posterior auricular cartilage was buried along the posterior surface of the old pedicle of the right ear, and the posterior auricular skin was likewise embedded beneath the posterior auricular skin of the right ear, behind the posterior auricular sulcus.

Likewise, the wedge-shaped piece of excised cartilage and skin were embedded beneath the skin, the cartilage being in a position which would correspond to the location of the upper portion of the new ear and its skin covering spread out above

A double pedicle skin-tubed flap was raised from the outer surface of the old pedicle of the right ear.

Second Operation: Twenty one days after the first operation a vertical incision was made over the wedge-shaped, embedded cartilage, the skin edges undermined and the ear skin which had been spread out above was brought down over the outer and inner surfaces of the cartilage. This ear skin was sutured to the edges of the peripheral skin which had been undermined.



AREA 1.—Drawing of congenital absence of the auricle, with an old pedicle of skin and fat from the arm and a rod of embedded rib cartilage from an unsuccessful operation twenty years previously.

FIG. 5. Drawing of Area A, showing embedded cartilage E, which was excised from the normal ear and its anterior and posterior auricular skin G, stripped from the cartilage except at the helix, and buried in a pocket above E. D is a double pedicle of tubed skin which was raised from the old pedicle F, for the reconstruction of the anterior portion of the helix.

FIG. 5′. A cross section of cartilage E and skin G; c representing the ear cartilage, a and b its skin covering which is spread out above.

A vertical incision was made over the skin of the embedded posterior auricular cartilage, the skin edges undermined and the buried posterior auricular skin was delivered and applied with its raw surface to the cartilage and sutured to the skin edges of the peripheral skin which had been undermined.

The lower end of the double pedicle skin tube was excised and attached in a new location, which would correspond to the crus of the new helix.

Third Operation: Six weeks after the second operation, the proximal end of the tubed pedicle was excised and sutured to the anterior part of the helix, and the tube was opened up for its entire length and sutured to a denuded bed The upper three fourths of the old pedicle was incised, the skin edges widely undermined, and this incision was converted into a Y-shaped incision The arms of the Y were sutured to the anterior and posterior edges, respectively, of the wedge-shaped pieces of ear skin after they had been freed

Fig. 6

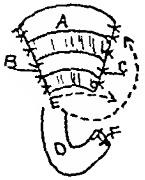


Fig. 7

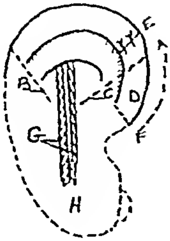


Fig. 8

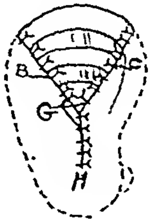


Fig 9

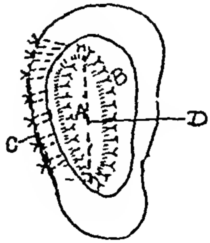


Fig. 10

Fig. 6. Drawing Showing the Wedge-shaped Piece of Cartilage A, Delivered from the Bed, with its Skin Spread out Over it

This anterior and posterior auricular skin was sutured to the peripheral skin of the scalp at B and C. The lower pedicle of the skin tube D, was detached and sutured to F, which is a point that corresponds to the crux of the helix.

Fig 7. The upper pedicle of skin tube D was severed and re attached to the helix of the ear at E, thus completing the anterior portion and the crux of the helix A vertical incision was made in the old pedicle at G and its bed widely undermined

Fig. 8 The wedge-shaped pieces of ear skin were freed from their scalp attachments at B and C and sutured to the edges of the upper part of the vertical incision at G; converting the vertical incision into a Y-shaped incision G.

Fig 9. A vertical incision was made through the skin of the old pedicle and the edges widely undermined. Subcutaneous tissue and fat were excised from the bed of the denuded area to form the shell of the ear The skin was rolled on itself posteriorly to form the inferior portion of the helix, and fixed with mattress sutures The denuded area was repaired by a thin, split skin graft A. A stint of dental impression material is shown at B.

Fig 10 The Completed Ear

Fourth Operation· Four weeks after the third operation, a vertical incision was made through the old pedicle extending from the inferior crus of the antihelix above to the upper part of the lobe below The skin was widely undermined anteriorly and posteriorly and rolled upon itself in such a way that it formed the inferior portion of the helix and the inferior portion of the antihelix The rolled skin was held in position by mattress sutures A large amount of subcutaneous tissue and fat were excised from the denuded area to simulate the symba and cavum The denuded area was covered with a thin, split skin graft and sutured into position An epithelial inlay was applied to the shell of the ear and over the skin graft.

11 12

13 14

FIG. 11. CONGENITAL ABSENCE OF THE RIGHT EAR WITH A PEDICLE OF SKIN AND FAT TRANSFERRED FROM THE RIGHT ARM NINETEEN YEARS AGO
FIG. 12. SIDE VIEW OF FIG. 11
FIG. 13 POSTOPERATIVE PHOTOGRAPH OF FIG. 11
FIG. 14. POSTOPERATIVE PHOTOGRAPH OF FIG. 12

Advantages of the Operation: (1) The material for the otoplasty was obtained wholly from the patient, thus complying with the principal that wherever possible, the patient's own tissues should be used in reconstruction.

(2) The pedicle of skin from the arm to the auricular region provides an ample amount of tissue for embedding skin and cartilage from the normal ear. In the subsequent modeling of the ear, there is an adequate amount of skin.

(3) The excision of skin and cartilage from the posterior portion of the normal ear is feasible in children as well as adults. It does not greatly interfere with subsequent growth of the ear, as demonstrated by the development which follows lop ear operations.

(4) The excision of the cartilage and skin from the posterior auricular region of the normal ear causes it to set closer to the head and makes it easier to match this ear with the new ear.

(5) The wedge-shaped piece of cartilage which is covered by its own skin, forms the upper part of the ear. This provides a thin, efficient framework, which prevents the new ear from folding on itself like a bud.

(6) On account of the thickness of the pedicle obtained from the arm, the ear shell can be carved more deeply to simulate a normal ear and the anterior thick skin of the pedicle which is not used, can be excised and replaced by a thin, split skin graft.

LIMITATIONS

(1) The operation is confined to patients with unilateral microtia and unilateral absence of the auricle. (2) The excision of the wedge-shaped piece of skin and cartilage from the normal ear of a child who has a very small auricle should not be done. This reduces the size of the ear from three-fourths to two-thirds its original size. However, unless the external ear is extremely small, this further reduction does not usually attract attention.

SUMMARY

(1) An operation has been described for the total reconstruction of the external ear. (2) Emphasis was placed on the early replacement of the auricle in both boys and girls for psychological reasons, and how very destructive this disfigurement might prove to the patient, if not corrected.

BILATERAL CLEFT LIPS

LOUIS W. SCHULTZ, M.D.

Chicago, Illinois

The bilateral cleft lip is the most interesting of cleft lips to correct because of the drastic change made in the facial expression. This type of cleft can be divided into two divisions; first, the incomplete cleft where the intermaxillary segment of bone is in its normal relationship between the maxillary bones and the cleft is not complete in the soft tissues; second, when the intermaxillary segment of bone is not attached to the two maxillary bones and is out on the tip of the nose and is attached to the septum and vomer of the nose. The soft tissues of the lips in this case are completely separated.

In bilateral clefts the bulbar tip of the nose often is depressed between widely spread alar cartilages. The columella may be wanting. The prolabium is small. The intermaxillary segment of bone is well advanced on the end of the vomer in front of the maxillary segments.

All of these deformities are present and are due to lack of muscle balance and restraint. The soft tissues can and should be restored to normal as soon as possible. *The maxillary segments should not be moulded because the clefts can be closed without this disturbance, which is detrimental to future development of the entire upper jaw.* The intermaxillary segment should be reduced to its normal position when the baby is one month old. This, done carefully, will not interfere with blood supply or growth, and is the key to future development.

Bilateral clefts are the most difficult to correct if a good result is the aim. As a rule, the intermaxillary bone is detached from the maxillary bones on one or both sides; this deformity should be corrected before the soft tissues are adjusted. The soft tissues including the muscles cannot force the intermaxillary bone to position between the maxillary segments and produce bony union of these parts. The difficulties encountered in trying to move the intermaxillary bone by draping the soft tissues over it are:—first, the length of time involved, for it takes months to get the bone even partially in place; second, the lip always has a lot of suture lines and excessive scar tissue in it because of the stretching; third, more operations are necessary to get rid of the scar tissue; fourth, this means sacrificing tissue that should not be lost if a perfect lip is desired; fifth, there never is bony union of the maxillary and intermaxillary segments when this technic is used; sixth, this correction takes so long that a speech defect results from the late closure; seventh, there are fistulous tracts, often permanent, leading from the vestibule of the mouth to the floor of the nose; eighth, the four central incisors in the intermaxillary bud are attached to the end of the vomer which is very uncomfortable for the patient. Furthermore, the patient cannot bite with these teeth because of the lack of bony attachment to the maxillary segments.

All these undesirable factors are avoided if the intermaxillary bone is brought to its normal position when the child is about one month old.

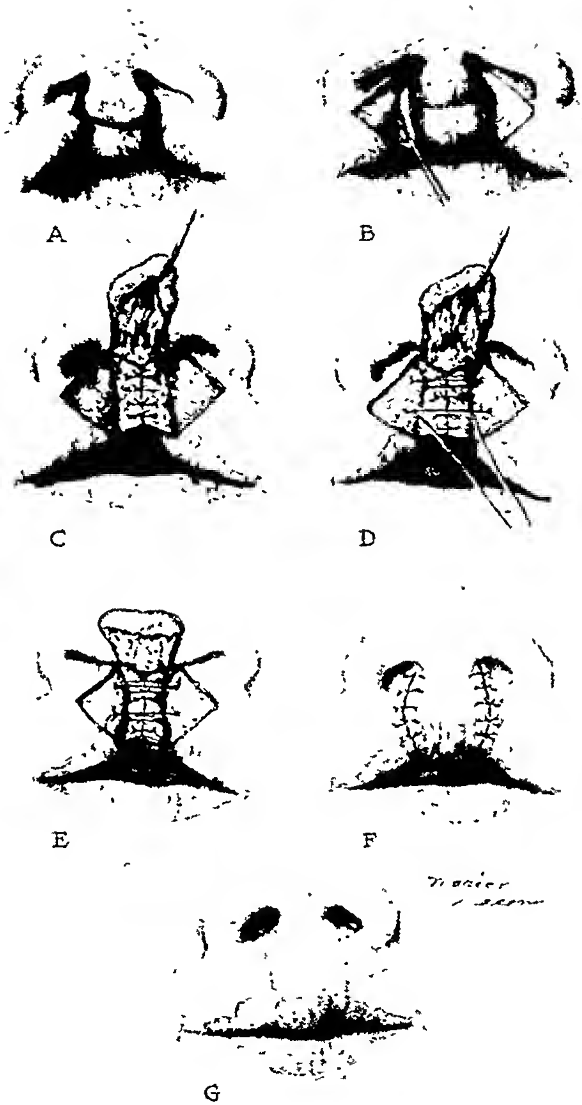


FIG 1 AUTHOR'S TECHNIC FOR BILATERAL CLEFT LIP RECONSTRUCTION

After correction of cases in this manner, the child develops perfectly including the intermaxillary segment. The technic for doing this work is very simple but it has taken years to acquire. One cannot be too meticulous in doing this

type of surgery. The care necessary in handling these tissues cannot be over emphasized.

The intermaxillary segment can be mobilized for reduction in two ways:—first, by making a submucous diagonal incision through the cartilaginous septum and then sliding one segment of the vomer over the other. This technic should not always be used for it may produce a nasal obstruction later in life. The other technic is to do a submucous resection of a small V-shaped section of the septum. The contact points of the intermaxillary segment with the maxillary segments are freshened by removing enough mucous membrane and periosteum to obtain bone to bone contact. The parts are fixed by passing a piece of No. 0000 nylon around the intermaxillary segment and passing mattress sutures of nylon No. 6-0 between them. This technic carefully carried out, results in bony union which is easily demonstrated. The baby should rest for at least one month and then should have the lip constructed by the technic the author has devised.

FIG. 2. RECONSTRUCTION OF BILATERAL CLEFT LIP BY AUTHOR'S TECHNIC

Not being satisfied with the results obtained in most bilateral cleft lip operations performed by various operators including myself, the author searched diligently for a method which would produce a more nearly perfect effect.

Having tried many of the methods described in the literature and obtained mostly poor results, the author finally devised the technic by which he can produce a much better lip in 98 per cent of these cases.

The first prerequisite to success is a large number of cases. The second is best expressed by the phrase: All the normal parts are there. All you have to do is unite them.

The transitional stages from the classical Bilateral Cleft Lip text book technic to the method now developed are evidenced by the cases the author has operated on over a period of twenty-five years. Fig 1.

The incisions are made so that all vermillion tissue is saved. The normal vertical lip length is that which closely approximates the length of the skin of the bud of lip tissue overlying the intermaxillary bone This small portion of skin and muscle develops to double or even treble its original size, sometimes very shortly after it is placed in its normal position between the lateral segments,

for then muscle tension exerts its influence on this highly important portion of lip. The lateral lip segments are prepared by starting an incision high in the lateral wall of the nose, and carrying it half way through the body of the lip to a predetermined point in the mucocutaneous junction. From this point it

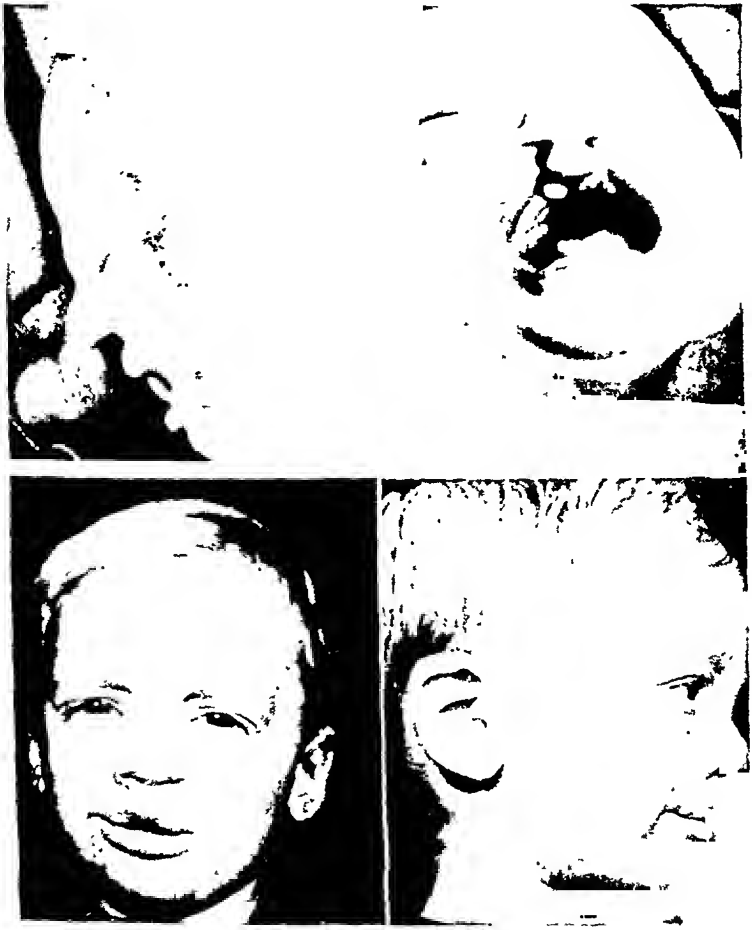


FIG. 3. BILATERAL CLEFT LIP SHOWN BEFORE AND AFTER CORRECTION

is carried medially and at the same depth through the lip, which shows when the lip is at rest. The lingual portion of this flap and one similarly prepared on the opposite side are joined later to form the lingual surface of the upper lip.

In the preparation of the central bud, all vermillion tissue up to its attachment to the gum is conserved. The incision is started high in the medial aspect of

the nose and carried down to a predetermined point in the mucocutaneous junction; then up through the mucous membrane, to its attachment to the maxilla to the median line. Then a similar incision is made on the opposite

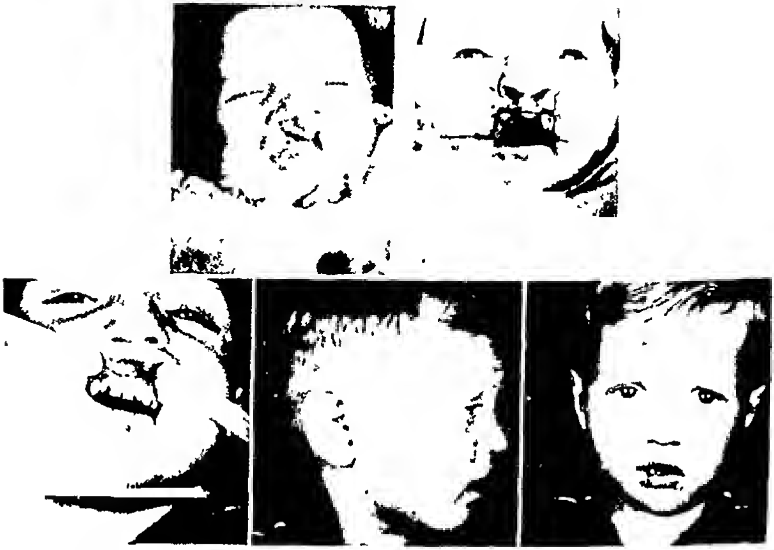


Fig. 4. Bilateral Cleft Lip Before and After Correction Showing Deep Vestibule, Normal Profile, and Lip Length

Fig. 5. Post-operative Bilateral Cleft Lip Showing Cupid's Bow, Full Thickness, and Normal Lip Length

side of the intermaxillary bud to correspond with the one just made. Now the central flap is dissected from the bone and so prepared that it fills perfectly the missing parts: (a) skin, (b) muscle and (c) mucous membrane, to give proper contour, thickness, length and width, and is turned up out of the way. The

lateral flaps containing the mucous membrane are turned lingually and united in the median line. The central flap is brought down and united with lateral flaps containing the skin—muscle to muscle, mucous membrane to mucous membrane and skin to skin. Interrupted chromic 0000 catgut sutures are used for the muscles, and interrupted nylon 6-0 for the skin and mucous membrane. The nostrils should be closed with iodoform gauze impregnated with compound

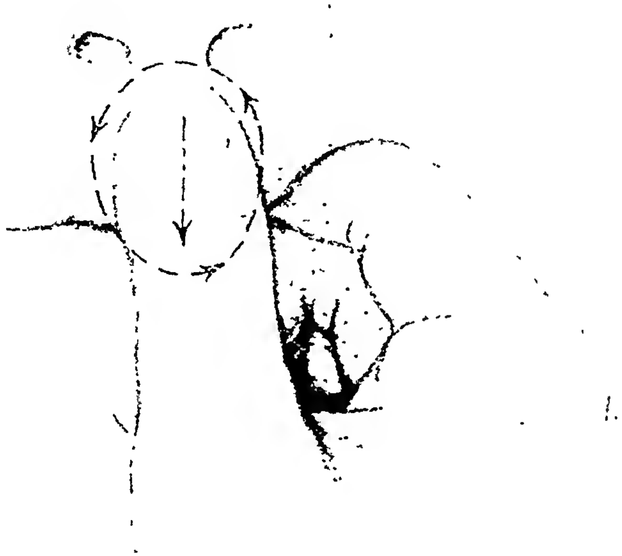


FIG. 6. SHOWING MASSAGE TECHNIC TO PREVENT LINEAR CONTRACTION

tincture of benzoin. The wound is to be kept clean and dry with saturated boric acid solution and cotton applicators when necessary. The Logan Lip bow can be used to advantage to relieve tension on the suture line.

The result is an abundance of mucous membrane to fill the central space formed by the dissection of the median flap from the bone. Thus, a good lip results with full thickness, including the cupid's bow, deep vestibule, and almost normal contour.

TWO CASE PRESENTATIONS[1]

GUSTAVE AUFRICHT M.D.

New York, New York

CASE I, INTRODUCTION

As early as 1896, only one year after the discovery of the roentgen ray, Daniel of Vanderbilt University observed that shortly after photographing a friend's skull with x-rays, the hair fell out. In the same year, Freund of Vienna employed x-ray for the treatment of a large hairy nevus on the back of a little girl. After similar experiences, it is quite natural that x-ray gave hope for the treatment of undesirable hypertrichosis, especially on women, and became an accepted treatment for a number of years.

However, these hopes were shattered by the damaging late reactions. Degenerative changes took place in the skin. Capillary lesions and obliteration, telangiectasis, degeneration and imperfect repair of the connective tissues, degeneration of the sweat glands and sebaceous glands, hypertrophy and keratosis of the epidermis were observed. The occurrence of ulceration and malignant changes were not infrequent. These deleterious effects, instead of eventual self-repair, manifested themselves in increasing degrees many years after the exposure. Therefore the treatment of hypertrichosis with x-ray is today generally abandoned.

CASE PRESENTATION

The patient is a forty-year old female who was treated about twenty years ago with x-ray for hypertrichosis of both forearms and face. Changes in the skin were noticed soon after treatment and during the years it gradually deteriorated, showing signs of atrophy, pigment deficiencies, and telangiectasis. About eighteen years after the exposure, the skin of the forearms began to break down in the mid section and ulcerate. For a while it responded to dermatological treatment, different salves, and protective dressings. Eventually it resisted all possible conservative treatment. Twenty years from the time of exposure, she presented extensive ulceration on both arms. The wounds were atrophic in some places, proliferative in others. They were extremely painful. The skin of the face had shown atrophy, pigment changes, and telangiectasia but no ulceration.

Operation. The entire x-ray affected area beyond the limit of the minutest signs of atrophic change, and with a narrow margin of healthy skin of the forearm, was excised. It included the extensor aspect, about one-half of the circumference of the arm, from the elbow to the wrist. The skin was removed with its subcutaneous tissue, including the antebrachial fascia. In the central part of the lesion, corresponding with the laceration of the ulcer, some of the intermuscular septa were removed. The same operation was executed on both arms. The defect on one arm was covered with Dermatome grafts of intermediary thickness (18/1000 of an inch) from the abdomen. The other arm was covered with grafts of about the same thickness taken free hand with a transplant knife from the thigh. Two Dermatome grafts were sufficient to cover the defect on the one arm; four strips of freehand grafts were needed for the other. The grafts were secured with continuous catgut sutures to each other and to the surrounding skin.

---

[1] Cases shown before the American Society of Plastic and Reconstructive Surgery, October, 1943

The grafts were dressed under pressure with dry gauze, leg-roll and bandage. The entire arm from shoulder to fingertips was immobilized with a plaster splint applied spirally around the arm. The spiral splint prevents motion in the joints, but affords easy approach to the dressing, in case of necessity, without removing it.

A

B C

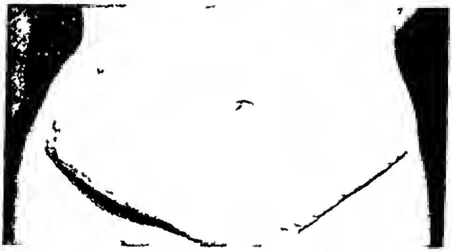
Case I. A Radio-dermatitis with ulceration and malignant changes of both arms. B & C Arms after grafting

The first dressing was done on the twelfth day post-operative. Except for minor intermarginal losses, there was a full take on both arms. After the first dressing the spiral splint was replaced for another week.

The donor areas were treated with silver foil against the wound and vaseline gauze over

A

B



C

D

Case II A & B Disfiguring defect of left leg C Abdominal skin tube formed. Mid-section still attached D Mid section of skin tube attached to hand E Mid section of skin tube attached to hand, right end attached to forearm F Patient in cast One end of skin tube attached to leg Mid section and other end still attached to forearm. G. Skin tube transferred to leg H & I Skin tube worked into leg to cover defect J & K. Final appearance with stockings

E

F

G

H

I

J

K

it Sufficient dry gauze and combine were applied The dressing on the donor area was left in place without changing it for three weeks, during which time full epithelization took place

Pathological report Squamous cell carcinoma

CASE II, INTRODUCTION

Occasionally surface defects on the leg are of serious aesthetic concern to the patient A case is presented herewith of a patient who suffered an extensive injury to the leg. While there was a full functional recovery, the appearance of the defect disturbed her considerably as she had theatrical ambitions and considered it a handicap on the stage. She was extremely sensitive and refused to leave the house without camouflaging the defect with a latex prosthesis or by other means

History A nineteen-year old girl was injured in an automobile accident, suffering a compound fracture of the left leg with extensive soft tissue injuries of the calf Gas bacillus infection set in While eventually it healed with a good bony union, considerable soft tissue, including musculature, was gouged out from the inner and posterior aspects of the leg There was no noticeable functional disturbance in spite of the apparent defect in the musculature Besides the deformity the scar was irregular, adherent, and unsightly In our first attempt, the irregular, mosaic like scarry surface was replaced by large sheets of Dermatome grafts from the abdomen The surface improvement was considerable About one year was allowed for spontaneous filling in and rounding out of the defect after the skin grafting There was some, but not sufficent improvement in this respect Eventually it was decided to use a well-padded skin tube from the abdomen to fill up the defect and reconstruct the contours

Operation A 4- x 16 inch transverse skin tube was prepared on the abdomen from hip to hip Four weeks later its midsection was detached from the abdomen and attached to the back of the right hand On the hand a semi-circular flap was formed for this purpose by which the defect and the reflected wound surface of the flap served as a source of blood supply About four weeks later one end of the skin tube was attached to the arm by a similar semi circular flap About four weeks later the other end of the tube was freed and attached to the lower end of the defect on the leg The patient's leg, hip, and arm were immobilized in an adequate cast About three weeks later, the proximal end of the skin tube was separated from the arm and attached to the upper part of the skin defect above the popliteal region The hand was freed in about another three weeks, the tube receiving sufficient blood supply through both of its ends Eventually the entire skin tube was spread and worked into the defect Except for a minor defect in the lower corner, the entire transplanted skin survived

While the large skin tube was not sufficient to cover the entire defect, it offered a considerable improvement in the contours, and with somewhat heavier stockings, the patient was able to camouflage, to a good degree, the imperfections The operative procedure was tiresome and at times extremely uncomfortable to the patient In her eager desire however, to overcome this aesthetic handicap, she carried through the entire procedure in high spirits

A SUGGESTED PYREX FORM FOR SUPPORT OF SKIN GRAFTS IN THE CONSTRUCTION OF AN ARTIFICIAL VAGINA[1]

NEAL OWENS, M.D.

New Orleans, La.

Dupuytren in 1817, (1) when first attempting to establish an artificial vagina, made an opening between the bladder and rectum and inserted a tampon into the newly formed vaginal cavity until epithelization took place. It is significant that this fundamentally sound procedure was advocated in 1817 and essentially forgotten until 1936 when Monod and Iselin (2) improved Dupuytren's original operation by applying Thiersch grafts over a hard stent and inserting the stent into the newly formed vaginal canal. From that time to the present numerous complicated and dangerous procedures were advocated. Rubber forms, plug bougies, packing, stents and tubes were used in an effort to establish epithelization of newly formed vaginal canals and patency of these canals was maintained by their constant dilatation.

Huff (3), in 1930, packed the vaginal cavity with vaseline gauze for 9 days and at the end of that time inserted a glass cylinder to preserve the size of the opening. Meigs (4) used a pyrex glass tube which was held in place with a T binder. Dannreuther (5) used glass vaginal obturators shaped much like the anatomic phallus, with the exception of a little indentation near the outer margin which precluded pressure on the overlying urethra. A silver-plated vaginal prosthesis, $1\frac{1}{2}$ inches in diameter and $4\frac{1}{2}$ inches in length was used by Word (6). In preference to sponge or other materials Esser (7) used dental compound, the measurements of the mold changing with the size of the patient. Frank (8) used 3 test tubes, preferably pyrex, respectively about $\frac{5}{16}$, $\frac{5}{8}$, and $\frac{3}{4}$ inches in diameter and, for the larger two, 6 inches in length. Three types of vaginal molds were used by Adams (9): the first was made of rubber sponge surrounding a wire framework; the second, of acrolite with multiple perforations permitting vaginal irrigations without removal; and the third, of rubber sponge covered with a condom. Holmes and Williams (10) used a small glass tube 0.8 cm. in outside diameter, then a longer tube 1.5 cm. in diameter and finally one 2 cm. in diameter. Sadler (11) used a tubular mold in preference to a solid one because it afforded better drainage; Wharton (12), balsa wood covered with a rubber condom; and Blocker (13), a mold of glass or bakelite. Counseller and Sluder (14) used a hollow lucite vaginal mold, 4 inches long and $1\frac{1}{2}$ inches in its greatest diameter. Whitacre (15) used a pyrex glass form with a groove sunk at the open end. The form was 11 cm. long, 3.2 cm. wide in the middle, and 3 cm. wide at each end.

The author proposes the use of a form so devised as to produce sufficient and constant pressure, and so supported as to distribute this pressure uniformly.

[1] (From the Division of Plastic Surgery, Department of Surgery, School of Medicine, Tulane University; Ochsner Clinic; Charity Hospital; Eye, Ear, Nose & Throat Hospital; Touro Infirmary.)

The form is made of pyrex and consists of 2 parts, an outer and an inner one. (fig. 1). The measurements of the outer form conform to those of a normal vaginal canal being 11cm. long and 3.5 cm. in diameter. This outer form is cylindrical in shape and is rounded at the end which is inserted into the vaginal canal. A small trough-like depression 1 cm. in width and 3 cm. in length is molded at the opening of the outer form in order to avoid pressure on the urethra

FIG. 1. PHOTOGRAPH SHOWING PYREX FORM OR OUTER MOLD WITH THE INNER MOLD WHICH HAS THE DISC PROJECTION FOR THE RECEPTION OF RUBBER TUBES ADJACENT

(fig. 2). The inner form, which is of hollow pyrex fits snugly into the outer one. (fig. 3). It can be removed to view the newly applied skin graft, while the outer form maintains pressure to the graft and remains snugly in place. The process of epithelization can likewise be observed at any given period. At the distal end of the inner cast (the portion which protrudes through the vaginal orifice) is attached a projecting disc. Two openings are formed in this disc for

the reception of rubber tubes, used to hold the form firmly in place after it is inserted into the vaginal canal. (fig. 4). The ends of the rubber tubes are firmly attached anteriorly and posteriorly to an abdominal belt above, thus forming a double sling to support the forms and hold them snugly in position. (fig. 5). The tubes pass anteriorly downward between the thighs, then through the openings in the disc, and upward posteriorly to follow the gluteal folds to

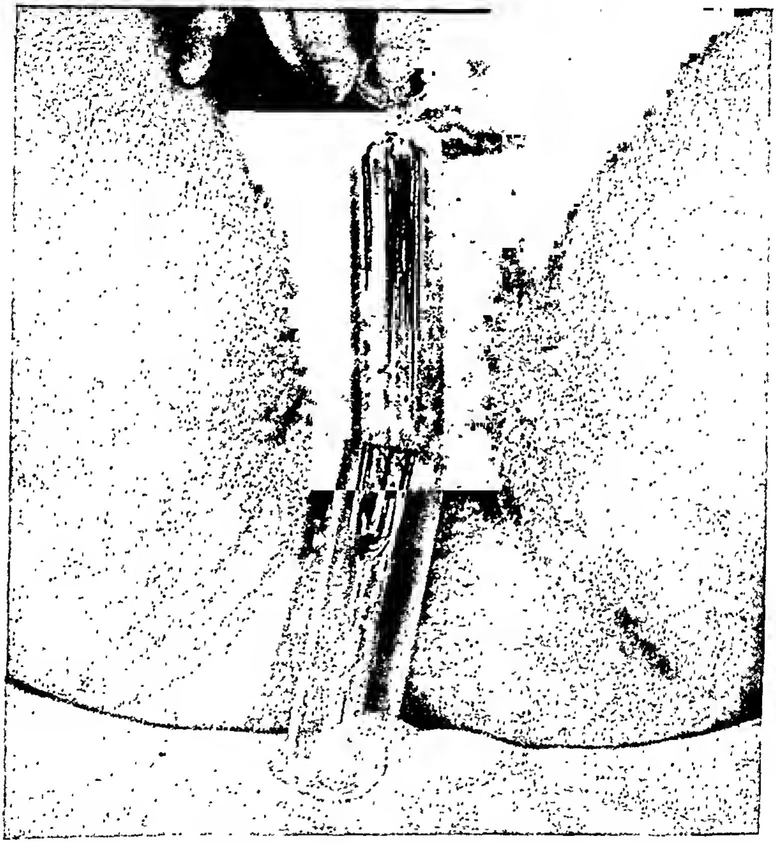


Fig. 2. Photograph Showing the Beginning of the Insertion of the Inner Form into the Outer One

become attached to the belt posteriorly. (figs. 6 and 7). When in place, they exert the proper pressure for maintaining the forms in a desirable fixed position under suitable tension. The graft is held firmly in place and is kept immobile and in intimate contact with the denuded surface of the newly formed vaginal canal. Little discomfort is experienced from the constant wearing of these new forms.

OPERATIVE TECHNIQUE

A tremendous number of procedures designed for constructing an artificial vagina have been described. Fundamentally three methods have been suggested for the surgical construction of an artificial vagina: intestinal segment transplant, either utilizing the small intestine (Baldwin- 1904)(16) or the rectum (Schubert

Fig. 3. Photograph showing the inner form completely inserted with the disclike projection for the reception of rubber tubes extending above the level of the outer form Note immediately beneath this the concavity in the outer form which is designed to prevent pressure on the urethra.

- 1914)(17), pedicle transplant (Heppner - 1872)(18); or by free skin graft (Abbe -1898)(19). The use of an intestinal segment transplant for the construction of an artificial vagina is much too complicated and reflects a mortality rate which is far too great. Similarly, methods employing single pedicle or tube pedicle skin transplants are objectionable because they require lengthy operative procedures and also necessitate lengthy periods of hospitalization. Massive scar

formation on the inner surface of the thighs may develop as a result of the extensive dissection required. By far the simplest method for constructing an artificial vagina is that method which forms a vaginal vault by blunt dissection and establishes a lining by the application of a half thickness skin graft.

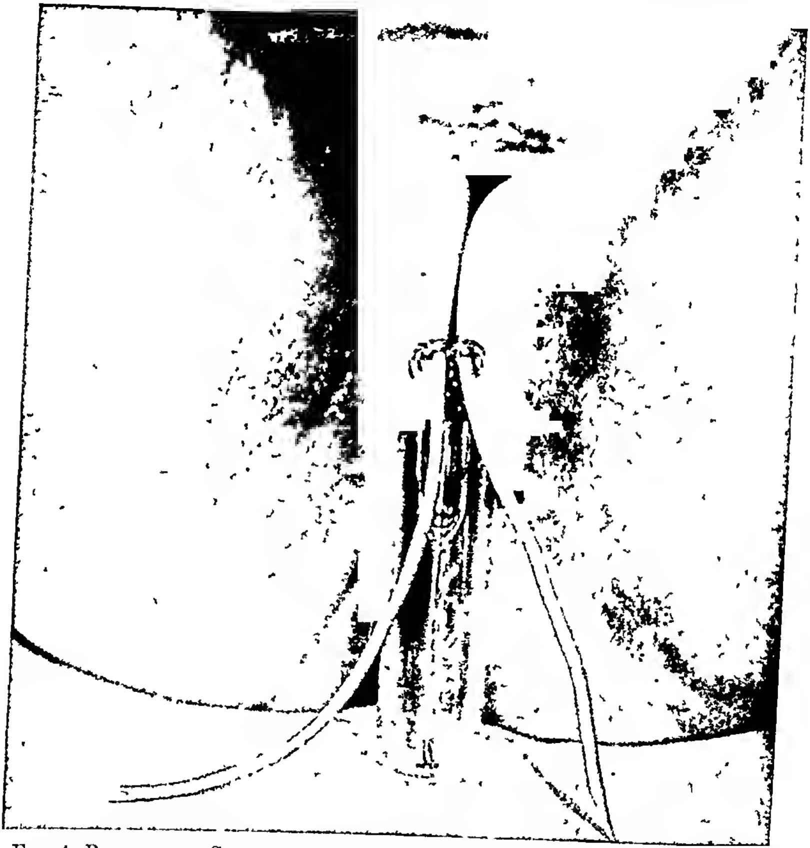


FIG 4 PHOTOGRAPH SHOWING THE MANNER IN WHICH THE RUBBER TUBES ARE INSERTED THROUGH THE HOLES OF THE DISC OF THE INNER FORM

A method for forming an artificial vaginal canal by blunt dissection and subsequent application of half thickness skin graft is described. A transverse incision is made between the urethra and the anus just inside the labia minora. Through this incision, with the index finger, a vaginal canal is established by blunt dissection between the rectum and the bladder Dissection is carried backward to a normal depth The usual precautions are taken not to injure the rectum or bladder and to avoid penetration of the peritoneal cavity. A half thickness

skin graft, large enough to completely cover the glass form, is then removed from the inner surface of the thigh, provided this region is sufficiently hairless, otherwise, it is taken from the inner aspect of the arm. The skin graft is then wrapped around the form, the skin surface adjacent to the surface of the form, and the form with its covering of skin is then inserted into the newly formed vaginal

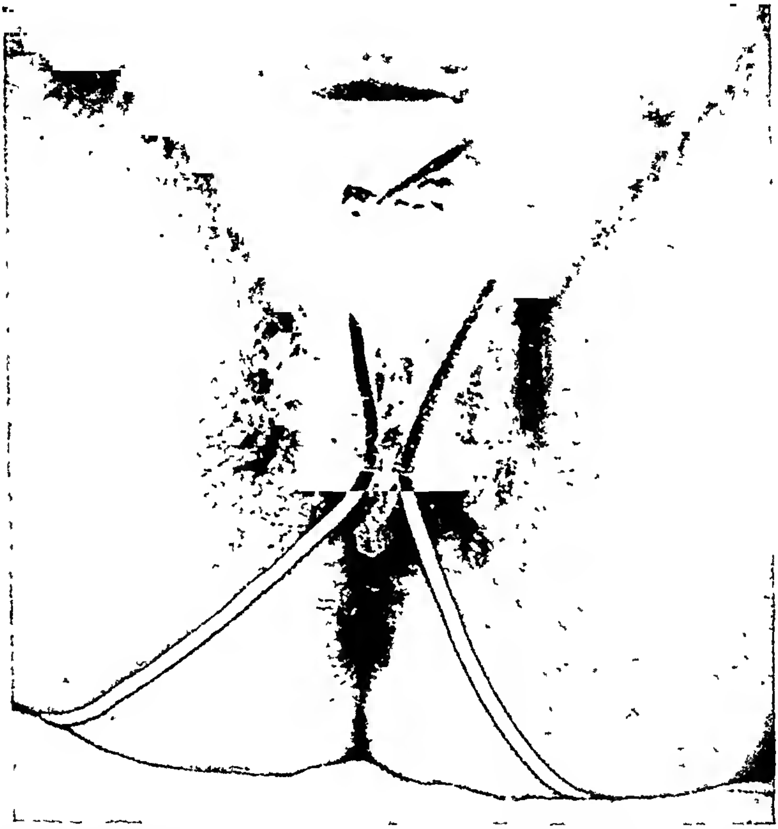


FIG 5 Photograph showing the two forms in place with the rubber tubes properly inserted through the holes in the disc and attached to the abdominal belt above anteriorly and posteriorly

cavity. It is necessary to keep the patient flat in bed for approximately ten days after which time the form may be withdrawn and the graft inspected. The use of the pyrex form with its insert permits inspection of the graft at any time without actually disturbing the graft or releasing necessary pressure. At the time the form is first removed the newly formed vaginal canal is gently rinsed

with a solution of normal saline. Following inspection of the graft the form is reinserted Ten days following the insertion of the graft the patient is permitted to sit up in a chair, the form being held firmly in position by means of the rubber tubes which support it.

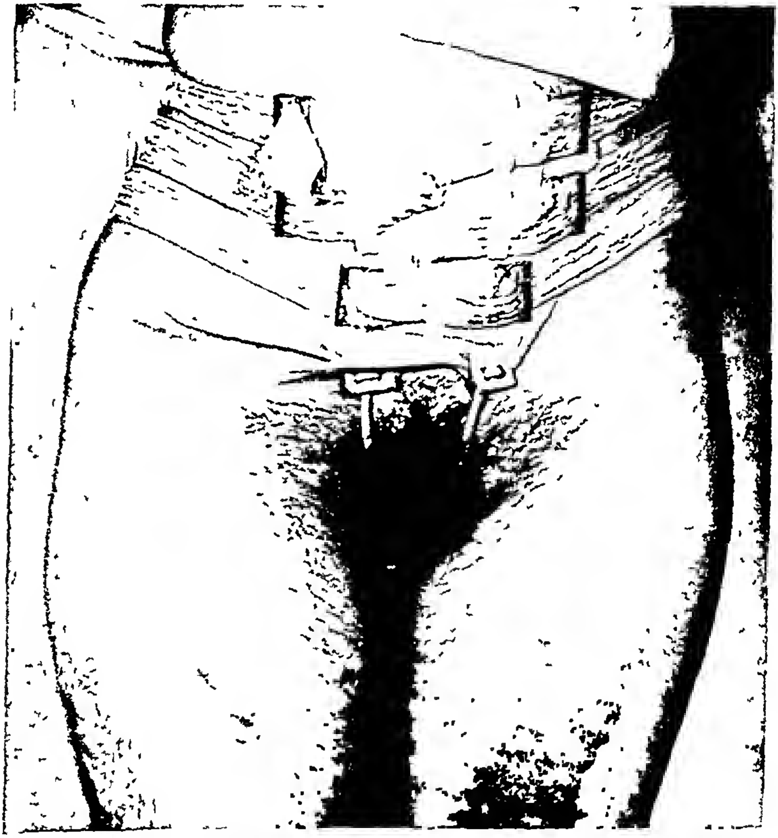


Fig 6 Photograph showing the anterior attachment of the two rubber tubes to the abdominal belt These tubes act as a sling support for the two pyrex forms when they are inserted into the vagina

When strength permits the patient may resume normal activity with the dilator constantly in place Because of the ease with which the form may be removed, daily douches may be taken and frequent inspection with cleansing of the canal may be made. The above routine insures normal expansion of the canal so that the desired pressure is constantly applied to the surface of the graft. Because of the pressure of the form against the graft, the entire lining surface of the canal is

constantly massaged, rendering it soft and pliable. The form should be worn for about six months in order to avoid contracture, which frequently results if the surface is not massaged and dilated for approximately that length of time. (fig. 8).

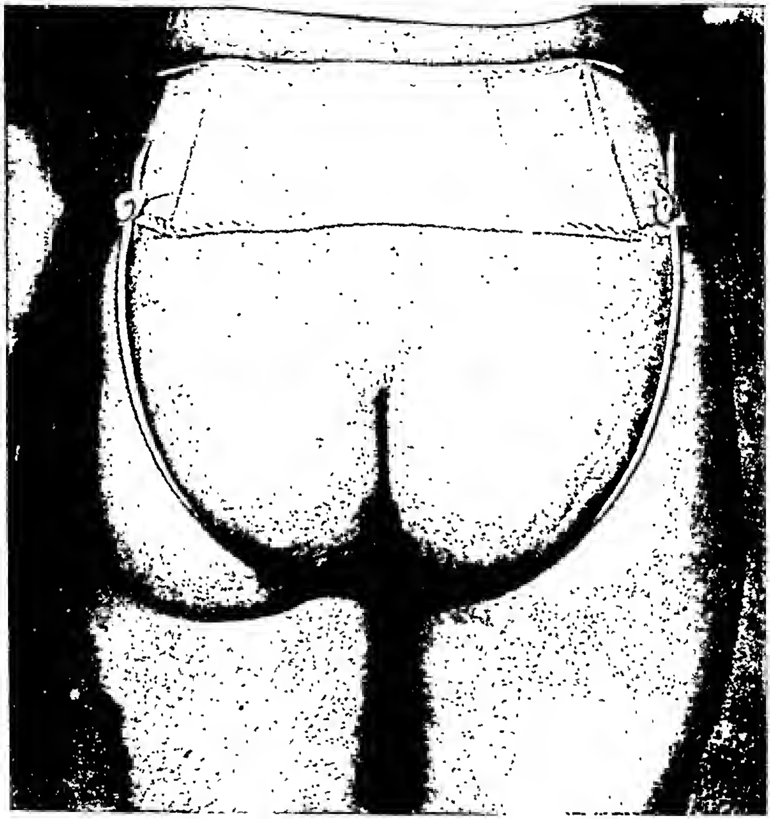


Fig. 7. Posterior View Showing the Manner in which the Tubes are Brought upward and Attached to the Belt Posteriorly

In conclusion, it is felt that there is every justification for surgical construction of artificial vaginae in these women who are otherwise normal. To deny them the opportunity of sex life because of the absence of a normal vagina is unnecessary, for the formation of a vagina has now become a comparatively simple surgical procedure, with an associated low mortality. Many of these women who otherwise would lead abnormal lives, with the aid of such an operation, marry and participate in satisfactory sexual relations, only lacking in the ability to conceive.

FIG. 8. PHOTOGRAPH SHOWING DEPTH OF THE RECONSTRUCTEO VAGINA AND THE SIZE AS REFLECTED BY A LARGE BIVALVE SPECULUM WHICH HAS BEEN INSERTEO

BIBLIOGRAPHY

1. Cited by Paunz, see reference 20.
2. MONOO, R. AND ISELIN, M.: Colpoplastie pour absence congenitale de Vagin par un procédé amelioré de greffes de Tiersch montées sur tuteur rigide. Mém. Acad. de Chir., 62: 997, 1936.
3. HUFF, W. B.: Congenital absence of the outer one-third of the vagina. Southern Med. Surg., 92: 592 (Aug.) 1930.
4. MEIGS, J. V.: Am. J. Obst. & Gynec , 35: 465 (Mar.) 1938.
5. DANNREUTHER, W. T. Partial congenital aplasia of the vagina. Am. J. Obst. & Gynec., 44: 1063 (Dec.) 1942.
6. WORO, B.: A silver-plated vaginal prothesis for the construction of an artificial vagina. Am. J. Obst. & Gynec., 39: 1071 (June) 1940.
7. ESSER, E.: Congenital absence of vagina; choice of operative procedure. J. Internat. Coll. Surgeons, 6: 496 (Sept.–Oct) 1943
8. FRANK, R. T.: The formation of an artificial vagina without operation (intubation method). N. Y. State J. Med., 40: 1669 (Nov. 15) 1940.
9. ADAMS, W. M.: Construction of an artificial vagina. Surg. Gyn. & Obst., 76: 746 (June) 1943.

10. HOLMES, W. R. AND WILLIAMS, G. A.: Formation of an artificial vagina without operation by the Frank method. Am. J. Obst. & Gynec., 39: 145 (Jan.) 1940.
11. SADLER, L.: Management of congenital absence of the vagina. J. Oklahoma M. A., 34: 382 (Sept.) 1941.
12. WHARTON, L. R.: Further experiences in construction of the vagina; 12 cases. Ann. Surg., 111: 1010 (June) 1940.
13. BLOCKER, JR. T. G.: Plastic construction. Texas State J. Med., 37: 345 (Sept.) 1941.
14. COUNSELLER, V. S. AND SLUDER, JR. F. S.: Treatment for congenital absence of the vagina. Surg. Clinics of N. A., pp.. 938–942 (Aug.) 1944.
15. WHITACRE, F. E.: Surgical treatment of absence of the vagina. Am. J. Obst. & Gynec., 49: 789 (June) 1945.
16. BALDWIN, F.: The formation of an artificial vagina by intestinal transplantation. Ann. Surg., 40: 398, 1904.
17. SCHUBERT, G.: Anatomic and topographic considerations for my operative method in vaginal defect. Zentralbl. f. Gynak., 47: 347, 1923.
18. Cited by Paunz, see reference 20.
19. ABBE, R.: New method of creating a vagina in a case of congenital absence. Med. Rec., N. Y. 54: 836, 1898.
20. PAUNZ, A.: Formation of an artificial vagina to remedy congenital defect. Zentralbl. f. Gynak. 47: 883, 1923.
21. OWENS, N.: Simplified Method for Formation of an Artificial Vagina by Split Skin Graft. Surgery, 12: 139 (July) 1942.

THE TREATMENT OF EXTENSIVE LOSSES OF THE SCALP

V. H. KAZANJIAN, M.D., AND RICHARD G. WEBSTER, M.D.

Boston, Mass.

Since the beginning of medical literature, cases of extensive loss of the scalp have been recorded. Many of these unfortunate patients were doomed to a delayed death from prolonged sepsis or intracranial complications. Those who lived often suffered through years of granulating wounds, sequestration of denuded cranial bones, and subsequent ulcerations and deformities occurring in or around large areas of cicatrization.

The acceptable methods of treatment used today have come about by a gradual development based on certain forward steps reported throughout medical history. However, these methods depend on the extent of the loss and the anatomy of the region for their proper selection.

ANATOMY OF THE SCALP

The skin of the scalp is thicker than that found anywhere else in the body. It is quite adherent to the superficial fascia and, therefore, is firmly attached to the underlying occipitofrontalis muscle and galea aponeurotica. Many of the hair follicles extend through the skin deep into the fat of the superficial fascia (fig. 1a). In the frontal, temporal, and mastoid regions the skin of the scalp is thinnest; in the occipital region it is thickest.

The superficial fascia binds the skin tightly to the underlying occipitofrontalis muscle and contains dense fibrous bands which run between lobules of fat. Laterally it continues over the temporal fascia to which it is not so firmly attached. Through it run the superficial blood vessels and nerves.

The occipitofrontalis muscle or epicranius consists of the occipitalis and frontalis muscles which are connected by the galea aponeurotica, a dense fibrous tendinous structure. The epicranius is connected loosely below to the pericranium by the subaponeurotic areolar tissue.

The subaponeurotic layer is made up of a network of loose areolar tissue containing no fat.

The pericranium or "external periosteum" is a thin fibrous membrane containing blood vessels and is loosely attached to the cortex of the outer table of the skull except at the suture lines where it is fairly adherent.

Arterial blood supply to the superficial layers of the scalp comes from vessels entering the scalp at its periphery (fig. 1b). The supratrochlear and the supraorbital arteries and the frontal branch of the superficial temporal artery supply the forehead, the anterior part of the scalp, and part of the temporal region. The parietal branch of the superficial temporal artery supplies that part of the scalp running from above the ear to the vertex. The posterior auricular and occipital arteries nourish the scalp posterior to the ear and in the occipital region. Although there is extensive anastamosing between these vessels on either side of the midline, there is relatively little connection between the vessels across

the midline. This fact is of vast importance in the selection of flaps to be used and of direction of incisions to be made in the scalp.

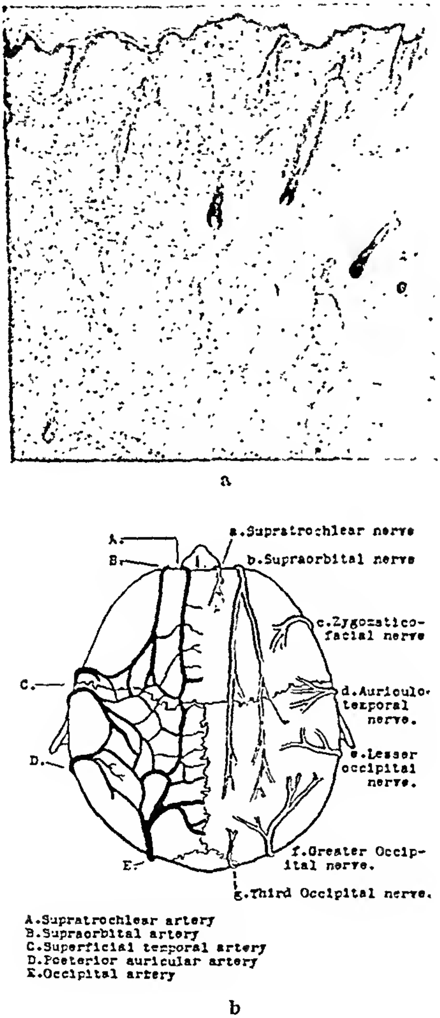


FIG. 1. (a) Photomicrograph of a cross section of scalp showing the hair follicles plunging into the fat of the superficial fascia.
(b) Diagram showing the arterial and nerve supply of the scalp. The veins follow the courses of the corresponding arteries.

The outer table of the skull is vascularized by vessels running in the pericranium and by the diploic vessels running between the inner and outer tables.

The large veins in the superficial layers of the scalp more or less parallel the arteries; but certain of them are connected by small veins, the emissary veins which pass through the skull, to the large venous intracranial sinuses. In addition, there are diploic veins which communicate with the meningeal vessels and the sinuses of the dura mater as well as with veins of the pericranium. By means of these vessels, infecting organisms can gain ingress to the intracranial vessels and produce meningitis, intracerebral abscess, or thrombosis of the large venus sinuses.

All of these anatomical features have relation to the peculiar results of trauma, to the treatment of losses of the scalp, and sometimes to the etiology of that loss.

ETIOLOGY OF LARGE LOSSES OF THE SCALP

a. Burns of any depth down to and including bone may occur. They may be caused by thermal agents (1, 2, 3, 4, 5, 6, 7, 8, 9, 10) including permanent waving apparatus (2), by chemical agents (11), by electricity (12, 13), or by radiation (14).

b. Impact of sharp (15, 16) or blunt (17, 18, 19, 20) objects—in the latter case, the wound is likely to present ragged edges, extensive crushing of the surrounding scalp, and, if the force has been applied in a glancing fashion or to a large area of the scalp, partial avulsion and marked tearing. If the object has been dragged over the scalp with much pressure, all of the layers and even part of the bone itself may be ground away. Automobile accidents where the patient has been pulled along a rough road may result in this type of trauma. As will be mentioned later, if an avulsion occurs, the level of separation is likely to be in the areolar tissue just under the galea.

c. Infection (15, 16)—severe sepsis resulting in thrombosis of blood vessels or in tense accumulations of pus under the galea has occasionally produced extensive sloughing of the scalp. Subgaleal hematomata can do the same thing. Syphilis and lupus vulgaris have been responsible for other large losses due to infection.

d. Scalping by paws of animals (21, 22) or by humans—in the past, Asiatics, Europeans, Africans, and the American Indians have scalped their victims (23). The custom is mentioned in Deuteronomy XXXII : 4 and in Maccabees II–VII : 7. Herodotus reported that Scythians scalped war victims in 1500 B. C. (Melpomene, IV, 64, Laurent's translation). Flaherty states that scalping was occasionally practiced among the white settlers of our country. Although of little importance today as an etiologic factor, these cases were at one time common and are significant in that the concept of treatment of the completely denuded cranium was introduced into this country in connection with them (24).

e. Industrial accidents—with the development of rapidly moving machinery of great power, large losses of the scalp were certain to occur. The first case due to machinery was that of Downs (47). By far the most frequent cause of

avulsion[1] of the scalp is the entangling of a female employee's hair in some type of machinery.

TREATMENT OF EXTENSIVE LOSSES OF THE SCALP

Historical note

In recorded medical history, there are many fascinating accounts of the treatment of large scalp losses. Before skin grafting had been discovered, these wounds had to develop granulations over which epithelium could grow from the sides. Where periosteum was lost over a large area, the outer table of the exposed skull often sequestrated before granulations could grow in from the sides or from the suture lines. Therefore, the main problem confronting the surgeon in early times was that of encouraging the covering of the bone by granulations.

Celsus (28) recommended perforation of the dry, blackened sequestrum with an awl or terebra; and Fabrice d'Aquapendente (29), following Galen's practice, advised rasping the denuded calvarium. However, these writers deferred action until delineation between the sequestrum and normal bone had occurred. Augustin Belloste (30) was the first to state that small perforations of the outer table should be made at the primary dressing of the wound, thus entirely avoiding exfoliation of the bone.

Replacement of the avulsed scalp was attempted in forty of 173 cases reported by Wheeler (31). In none did the scalp survive. Malherbe, in 1898, replaced the entire scalp with complete healing in ninety-eight days (32). However, the scalp died and was converted into a parchment-like covering under which healing occurred without complications.

A new landmark in the treatment of these cases was ushered in with the discovery of skin grafting. Netolitsky (34) was the first man to utilize skin grafts to hasten healing in an extensive loss of the scalp; he used full thickness grafts from the dorsum of the hand. Bartlett (35) was the first man in this country to employ Reverdin grafts in these cases. Abbe (36) in one case used 14,000 Reverdin grafts over four years to effect healing. In 1889 Socin (37) first employed Ollier-Thiersch grafts for losses of the scalp, and Balas (38) was probably

[1] By complete avulsion, we mean a separation of the scalp so that the detached portion has no attachment to the surrounding or underlying tissues. A partial avulsion is one in which the detached portion is still attached in some part to the surrounding or underlying tissues. It is rare indeed that the entire scalp is completely avulsed.

In 1911, Davis (25), in an important work on this subject reported ninety-two cases of complete avulsion of the scalp; of these, eighty-one were due to machinery. In all of the industrial cases reported only one male has suffered a complete avulsion. This was a Chinese whose queue caught in the centrifugals of a sugar mill (26). When entangled in machinery the tremendous tensile strength of the hair and the firmness with which the hair is attached to the scalp cause the latter structure to be ripped away from the cranium. In only one case (27) has the hair been torn out leaving the scalp intact. Ordinarily the line of tearing begins in some portion of the scalp where the skin is thinner. Quite often the supraorbital rims seem to act somewhat as knives against which the thin skin of the upper lids is cut. The line of cleavage is usually in the loose areolar tissue just below the occipito-frontalis muscle. The periosteum is often left intact but may be taken away with the scalp or may be ripped up but left attached as a periosteal flap. Rarely is the skull fractured. Parts of one or both ears are frequently carried away with the scalp.

the earliest to report the complete covering of the scalp with Ollier-Thiersch grafts at one operation. Recorded are many cases where the "small deep grafts" of Davis, skin from other individuals, cadavers, and animals (chickens, dogs, frogs, etc.), the lining of cysts, and amniotic membrane were used.

The early authors were wont to believe that skin grafting should not be attempted until granulations had developed on the periosteum. Robinson (39) was one of the leaders in the next forward step, for he stated that grafts would readily grow on the primary wound surface.

The next progress in the treatment of these patients was the development of the use of flaps. Gould (40) used a pedunculated flap from the back of the neck in 1908. Banks (41), Gillies and Kilner (42), and others have employed tubed pedicle flaps; New and Erich (43), Cahill and Caulfield (44), Otto (45), Mitchell (46), and others have developed ingenious methods for employing the scalp remaining to produce superior functional and cosmetic results.

General care of these patients

If a patient is brought in shortly after the accident and is hemorrhaging, the bleeding vessels should be secured and tied. If blood loss has been marked *blood transfusions should be given. Pressure and elevation of the head* will control most of the bleeding. Morphine sulfate or a similar drug of choice should be administered if pain is severe. Some have recommended anti-gas gangrene serum but most of these cases will not require this. However, anti-tetanus treatment as soon as the patient is out of shock should be given. Examination for other trauma including X-rays of the skull and a thorough neurological examination to rule out intracerebral injury should be done. Full doses of penicillin and/or sulfadiazine should be started.

True shock due to loss of blood is relatively rare in these cases, but the so called "neurogenic shock" is probably responsible for some of the accounts of shock in the literature on these patients. Judging from our cases and the references, we feel that skin grafting can be done immediately in most of these patients.

We consider a total loss of the scalp the equivalent of a burn of the same size and with the donor sites which are created in the removal of grafts for the scalp a total surface wound of appreciable size is present. Such a wound will heal best if the patient's general condition is maintained at an optimal level. If the wound becomes infected and suppuration is added to the patient's burdens, severe debilitation may well result. Therefore, we put the patients on a 3000–4500 calorie diet. This is divided so that twenty per cent of the calorie intake is from protein, sixty per cent is from carbohydrate, and twenty per cent is from fat. In addition supplements of vitamins A, B complex, C, and K are given. Ferrous sulfate in large doses is added. Frequent laboratory tests of hemoglobin and serum protein are done. If the hemoglobin level falls below seventy-five per cent, blood transfusions are given; if the serum protein falls, intravenous protein hydrolysates or plasma are given.

No adult is allowed to remain in bed, for we feel that early mobilization aids

in maintenance of good morale, prevention of phlebothrombosis, and quick recovery of strength.

If the scalp is brought in with the patient and is not used, the hair should be saved, as a transformation can be made from it for the patient to wear later.

In the old suppurating case, the supportive treatment mentioned above is particularly important. No attempt should be made to skin graft this type of patient until his general condition is good and until the local wound has been cleaned and presents a satisfactory base for grafts.

Treatment if the periosteum is intact or present. (*Cases 1 and 2*)

As soon as the patient's condition will stand it, general anesthesia should be given and the wound cleaned and debrided. Normal saline is probably the safest irrigant; but if there is much dirt present, a mixture of green soap and hydrogen peroxide has been used with success. As little as possible of the remaining attached scalp should be removed, as the structure is so vascular that most or all can usually be saved.

If the defect is small, it often can be closed by extensive undermining in the subaponeurotic layer with relaxing incisions or cross hatching incisions made from below through the galea but not through the skin or superficial fascia. In the extensive cases every effort should be made to give the patient a closed wound as soon as possible by skin grafting. Later, if some hairbearing tissue is left, it can be swung or migrated as flaps to the areas most strategic from the cosmetic point of view. Doing such a thing in the presence of a suppurating or granulating wound is not good surgical practice.

If portions of periosteum have been lifted up as flaps, they should be sutured back in place. In the latter case as little as possible should be excised. Those areas where bare bone is left should be treated as mentioned in the next section.

If flaps of scalp are present, they should be sutured back in place, as history has shown how many of these survive even with very small pedicles.

Ample experience has demonstrated that the periosteum is vascular enough to sustain skin grafts. It is not necessary to await granulations, for the chance to graft on a surgically clean field rapidly slips away with the hours.

We have ordinarily chosen thick split thickness grafts cut with the dermatome. The thinner Ollier-Thiersch grafts do not give as functional a result as the former; Reverdins, the "small deep grafts" of Davis, and postage stamp or cobble-stone grafts leave granulating areas between them which later develop into troublesome scars. Full thickness grafts taken in quantity enough to cover an entire scalp leave donor areas too large to be closed with ease and would be a major procedure in their obtaining alone.

It has already been mentioned that replacement of the avulsed scalp has been unsuccessful. The main reason for using the avulsed scalp would be to replace hairbearing skin. However, in order to apply it as a full thickness graft, galea and fat would have to be removed; in doing this, the original purpose of the procedure is defeated for so many of the hair follicles plunge deeply into the fat. In addition, the skin itself is so thick that it is far less likely to "take"

than are the split thickness grafts. It has been suggested that Ollier-Thiersch grafts be cut from the avulsed scalp if it is in good condition.

We have not done this nor have we taken split thickness grafts from it; but there is no reason to assume that such a procedure might not be satisfactory, except the possible difficulty in cutting such grafts with a dermatome.

The split thickness grafts may be sutured to the shaved edges of the remaining scalp and to each other; or if time is precious because of the condition of the patient, they may be laid on the wound with edges overlapping. A pressure dressing is applied; and as soon as the patient is conscious, the head of the bed is elevated eighteen or more inches.

If the grafts are to be sutured in place, the operation is likely to be a long affair; hence it is advisable to have two dermatomes and the donor areas covered with rubber cement before starting the anesthesia. The donor site dressings should all be prepared beforehand. In this way the grafts can be cut and the donor sites all dressed in less than fifteen minutes.

If the entire scalp cannot be grafted at once, it is wise to graft the anterior part of the defect first as it is here that contractures resulting from excessive scarring produce their most horrible deformities (severe ectropia of the eyelids). One large dermatome graft laid across the forehead gives the best cosmetic result (case 1).

It should be mentioned here that in the shaving of the remaining scalp, great care should be taken to prevent the hairs from getting into the wound. Should any do so, they should be meticulously removed (irrigating alone often will not do this).

Case 1. Age 28–Unit No. 476573, Massachusetts Eye and Ear Infirmary, Admitted: 1/23/45.

This patient was admitted to the Massachusetts Eye and Ear Infirmary twenty-seven hours after her scalp had been completely avulsed in a stitching machine. On admission, the patient showed ecchymosis of both lower eyelids, her pulse was 110, and her temperature was 101°. She was immediately started on sulfadiazine by mouth and was given intravenous glucose and saline.

On the next day the dressing was removed in the operating room, and the wound found to be so clean that operation was feasible. One small area at the vertex was denuded of periosteum. The line of tearing ran below both eyebrows and across the bridge of the nose. The upper half of the right ear was torn away, and only a few centimeters of hair-bearing tissue remained at the nape of the neck (fig. 2). Under GOE anesthesia, three dermatome grafts were taken, two from the abdomen and one from the thigh, and were used to cover the anterior two-thirds of the scalp. No more was done at this time because of the patient's condition. She was given intravenous glucose and saline and 1500 ccs. of blood and plasma. Intramuscular penicillin was started. The culture of the wound at the time of operation was coagulase positive hemolytic Staphylococcus aureus. During the ensuing days, the patient was given blood plasma and blood as indicated by laboratory tests. The skin grafts "took" practically 100%, but the first post-operative dressing done five to six days later showed the ungrafted area to be badly infected.

Seventeen days post-trauma the ungrafted portion on the head showed hemolytic Streptococcus, coagulase negative Staphylococcus albus, and Bacillus pyocyaneus. Dakin's Solution irrigations were started and were followed by frequent warm boric acid compresses.

On the thirtieth post-trauma day, under ether anesthesia, two dermatome grafts were

removed from the back and were sutured to the posterior portion of the head. These grafts in the region of the vertex where the blood supply was poorest and where the periosteum had been partially denuded, did not "take".

On the sixty-fourth day post-trauma, a skin graft from the left thigh was applied to the unhealed area under pentothal anesthesia.

On the seventy-sixth hospital day, the patient was discharged (fig. 3). For a while, there was a tendency for the areas to break down where the grafts had been sutured together. The patient now wears a transformation (fig. 4), sensation is returning, and the skin moves loosely over the bone. There is no retraction or eversion of the eyelids.

FIG. 2. Appearance of Case I at the first dressing about twenty-four hours after trauma. The line of tearing runs below the eyebrows and involves the right upper eyelid. The periosteum is almost entirely intact.

Case 2. W. B.–Age 35–Unit No. 497336, Baker Memorial, Admitted: 7/23/45.

Two hours before admission, the patient's hair caught in a power lathe. The scalp was completely avulsed. The line of tearing went below the eyebrows across the bridge of the nose, along the left zygomatic process, through the left ear just above the tragus, along the neck leaving about one centimeter or so of hairbearing tissue, then to the right ear and along the right zygomatic process (fig. 5.). Cotton dressing had been applied, and the scalp which had been somewhat mangled was brought to the hospital one half hour later (fig. 6a). The patient was alert, had marked pain, and the blood pressure was 130/75. The pulse rate was 120; in the operating room later the patient developed auricular fibrillation. There were several small periosteal tears but no real loss of periosteum. About one half hour after admission she became nauseated and vomited partially digested food. There were no other injuries.

Under intratracheal GOE anesthesia, the raw area was irrigated and washed free of all debris. We were urged, in spite of our better judgement, to reapply the avulsed scalp to see

if, with antibiotics, sulfadiazine, and improved supportive treatment, the scalp might live. Therefore, the scalp was shaved under sterile conditions, sprayed with quarts of saline solution, trimmed free of fat in one place, and then carefully sutured back in position. Small

Fig. 3. Photographs showing appearance of patient shortly after discharge. The lines of junction of the dermatome grafts can be seen. Also the extent of hairbearing tissue left after the avulsion is demonstrated.

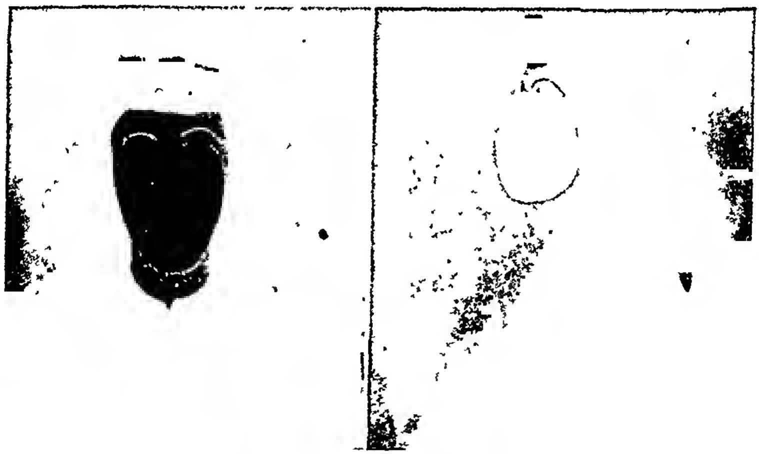


Fig. 4. Appearance of patient with her transformation and with eyebrows penciled on forehead. There is no retraction of the eyelids and the excellent result of a single large dermatome graft across the forehead is illustrated.

incisions were made in it for serous drainage (fig 6b) The patient received 500 ccs. of whole blood while on the operating table and was put on full doses of penicillin and sulfadiazine post-operatively.

On the eighth post-trauma day, some areas of frank necrosis were found at the first post-

operative dressing; but the majority of the scalp appeared to be questionably viable. For over two weeks the patient's chart ran an essentially flat course.

On the sixteenth post-trauma day, the dressing was removed. Much of the scalp was obviously necrotic (fig. 7a). The necrosis presented two pictures: most was leathery and dark purple to black in color, the rest was soggy and yellowish white. A large area at the vertex had an appreciable accumulation of serum under the scalp. About five to eight

a b c

Fig. 5. Admission photographs of case 2

(a) View showing the line of tearing involving both upper eyelids, going across the dorsum of the nose, along the zygomatic process, and through the upper part of the auricle.
(b) Photograph showing damage to other ear.
(c) View demonstrating extent of avulsion and showing a tear in the periosteum in the shape of a V near the frontal bone.

per cent of the replaced scalp was definitely viable in the region of the right forehead and temple (fig 7b). This was where fat had been trimmed away at the original procedure. Under spinal anesthesia a thick dermatome graft was taken from the lower abdomen and another from the outer left thigh. In the region of the vertex the scalp had been lifted up by serous exudate and was debrided away. The grafts were sutured into this defect (fig. 7c). The culture from the scalp showed nonhemolytic Streptococcus.

a

b

FIG. 6: (a) Photograph showing the avulsed scalp with eyebrows and part of ear attached after shaving.
(b) Photograph of patient at end of first operation showing the replaced scalp with multiple stab wounds for purposes of drainage.

On the twenty-first post-trauma day, the dressing showed approximately 100% take of the skin grafts.

On the forty-ninth day after the accident, under spinal anesthesia followed by pentothal anesthesia, two dermatome grafts were taken from the right thigh and applied to the com-

a

h c

FIG. 7. (a) Photograph showing appearance of scalp sixteen days post trauma The two types of necrosis mentioned can be easily seen. Part of the leathery necrotic area near the vertex has been excised and the granulating base left below is visible

(h) The area of "take" can be seen jutting into the whitish soggy necrotic area on the forehead

(c) Photograph showing two dermatome grafts applied superiorly where necrotic scalp had been removed

pact vascular granulations across the forehead and in some of the other uncovered areas. By this time during the dressings, all done in the operating room, most of the necrotic scalp had been surgically removed.

On the sixty third post-trauma day, under GOE anesthesia, the dressing was removed

and much of the remaining slough was found to have disappeared on the Dakin's irrigations. Two dermatome grafts were taken from the upper abdomen and sutured into two uncovered areas on the head.

There was an excellent take of the skin grafts applied at both of the last operations

a b c

Fig. 8. Photographs showing the grafted scalp and demonstrating the almost total loss hairbearing tissue.

a b

Fig. 9. Patient wearing transformation. She has penciled in the eyebrows. There is no ectropion of the eyelids.

On the eighty-seventh post-trauma day, under 1% novocaine infiltration and GOE anesthesia; a dermatome graft was taken from the posterior left thigh and applied to the remaining unhealed area.

The grafts applied at this operation showed 100% loss. This occurred during a time

when the patient was in bad nutritional state. The culture from the head wound showed moderate Staphylococcus aureus and a few non-homolytic Streptococci. On wet dressings the unhealed areas epithelized over and the patient was discharged on the 118th post-trauma day (fig. 8). While in the hospital she had become a tremendous problem because of continuous anorexia and gastro-intestinal upsets.

Since that time the patient has shown a tendency to ulceration in the suture lines and in the areas which healed without grafting. This tendency has markedly diminished, however,

FIG. 10. Four views showing the return of sensation almost a year after the accident. Above the upper black line there is no sensation. Between the two black lines the patient has protopathic sensation.

and she is able to wear a wig comfortably with a small dressing over the scalp for protection (fig. 9). Sensation is coming back fairly rapidly (fig. 10).

Treatment if there is loss of periosteum

One cannot expect skin grafts to "take" on the denuded cortex of the outer table of the skull. Therefore, if flaps are not available from adjacent tissues to cover the denuded bone, some method of obtaining a vascular bed for the grafts must be accomplished.

Ordinarily, this is best done by establishing connections with the diploic

vessels which lie between the two tables of the skull and send branches into these tables. The older methods consisted of boring holes with trephines, awls, dental burrs, etc., or rasping away the outer cortex until bleeding points were found. Boring holes which have to be situated closely together is a laborious procedure and is uncertain in its results for the granulations which grow out of the holes thus made require time to unite and completely cover the bone left between the holes. The use of rasps and the dental burr produces enough heat to delay healing.

We have found the most satisfactory and simplest method to be that of chiseling away the outer cortex until multiple bleeding points showed themselves. In one week or slightly more, the granulations springing from these numerous bleeding points coalesce and produce a fine carpet of granulations ideally receptive to grafting. We present a case showing the use of burr holes and of shaving away the dense bone with a sharp chisel. It is immediately obvious that the latter procedure was superior (case 3).

Thin grafts have taken well on bone "freshened" as mentioned just above; but with the thicker grafts used here, it is probably wise to wait until the bed of granulations has developed.

In summary here, if denuded bone cannot be covered immediately with flaps, we chisel down to bleeding points, graft the areas where periosteum is present, wait until granulations are present in the denuded areas, and then graft these.

Case 3. R. B.–Age 61–Unit No. 467609, Massachusetts General Hospital, Admitted: 11/24/44.

Fifteen years before entry the patient noticed a red scaling lesion on the left temple. This gradually increased in size until on admission it was about five by seven centimeters in size (fig. 11a). Six months before admission the center became raised and the entire lesion ulcerated. In the year before entry two other small lesions developed, one in the center of the forehead and the other near the outer canthus of the right eye.

On 11/3/44 the patient received X-ray therapy to the latter two small lesions which were diagnosed as intradermal basal cell carcinomata. On admission, besides the lesion in the temporal region, the patient's only abnormal finding was a blood pressure of 240/130.

Operation, 12/4/44: Intratracheal GOE anesthesia. The lesion and one-half to one inch of seemingly normal skin around it were excised. In the most medial region where the lesion had heaped up it was necessary to remove periosteum over an area approximately 2½ x 4½ centimeters in size. In order to produce granulations in the area of periosteal denudation several small burr holes were made through the outer table of the skull (fig. 12a).

Dressing, 12/22/44 or eighteen days later: The skin graft which had been placed over the defect where periosteum was still present had taken well, but the area where the burr holes had meen made showed only a few granulations in each burr hole (fig. 12b). The bone between the burr holes was dry. Using no anesthesia, the bone was chiseled away with a sharp chisel until multiple small bleeding points were seen (fig. 12c).

On 12/29/44 or seven days after the bone was chiseled, a dressing showed the entire surface of the denuded bone to be covered with a carpet of fine vascular granulations (fig. 12d).

On 1/4/45 or thirteen days after the outer cortex was chiseled, a dermatome graft was applied to this area with an excellent take (fig. 11b).

Complications of inadequate early therapy

In the literature and in our own experience the late complications which are most serious may be grouped under two headings:

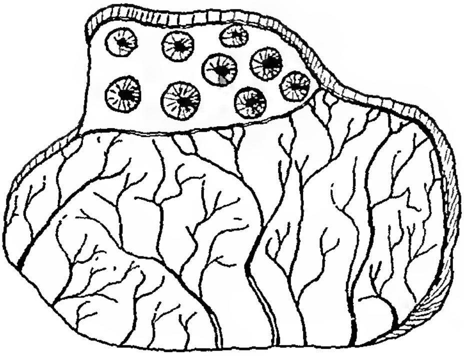
(1) Complications caused by late contracture. These are most likely to involve the eyelids and in particular the upper eyelids for the injury is ordinarily above the eyes. Several cases have been reported in which, after extreme retraction and eversion of the lids, the patient has lost an eye Case 4 in our series illustrates this marked ectropia very well. It is most likely to occur in those patients whose eyebrows have been involved in the avulsion, and the logical way to avoid it is to graft this area as early as possible One large dermatome graft sutured across the forehead as was done in cases 1–2 gives a pleasing cosmetic result, for the suture lines are minimal and can often follow natural lines on the face. There is little doubt that if one is confronted with a situation

a b

FIG 11 (a) Photograph showing the size of the carcinoma of this patient's forehead and scalp (Case 3) At the upper anterior margin can be seen the portion which required excision of periosteum
(b) Appearance at discharge showing the two skin grafted areas

where the entire wound cannot be grafted at once the anterior portion should take precedence over other areas Case 5 shows ectropion of the lower lid of a patient in which the wound went beneath the lower lid

(2) Complications caused by breakdown of scar epithelium The photographs in case 4 show how thin and how tightly stretched the skin is in those areas which are inadequately grafted soon after trauma Through this thin epithelium blood vessels can easily be seen Because sensation takes many years to return



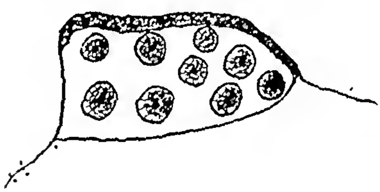
a

Fig. 12. (a) Diagram showing the appearance of the wound left after excision of the lesion (life size). Nine burr holes were made in the part devoid of periosteum. The periosteum covers the rest of the wound surface and is shown with its blood vessels.

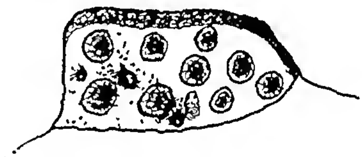
(b) Appearance of the area of periosteal denudation. In each burr hole a few granulations have developed. There has been no spread of granulations over the cortical bone [illegible] have passed since the first operation.

[illegible] the cortical bone being chiseled down to multiple bleeding points.

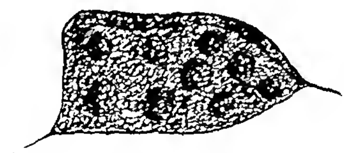
(d) Diagram showing the appearance of the wound seven days after the bone was chiseled away. The entire wound is covered by a carpet of granulations.



b



c



d

in some cases and never completely returns in others, the scarred area is particularly subject to trauma. The blood supply toward the vertex in these cases is also often inadequate. Therefore, recurrent ulcerations which heal very slowly are exceedingly common.

As would be expected in such an unstable area, carcinomatous degeneration does occur and cases 6 and 7 illustrate this well. The treatment of one is discussed in some detail for it shows a satisfactory method of repairing the extensive loss entailed in the resection of the carcinoma and of the unstable skin.

Case 4. A. D.–Age 52–Unit No. 231331, Massachusetts General Hospital, Admitted: 5/27/40.

Twenty-six years before entry the patient caught her hair in a revolving shaft in a shoe factory. She suffered a complete avulsion of her scalp involving both eyebrows and all of the right ear except the lobe. The periosteum was also removed. Repeated Thiersch and pinpoint grafts did not take and the last grafts were applied seventeen years before entry. There had been no growth of skin from the side until eight years before entry when, following scarlet red applications, the wound finally healed with thin scar epithelium. It since

a b

Fig. 13. (a) Admission photograph showing the extreme retraction and ectropia of the upper eyelids (Case 4).
(b) View illustrating the ulcerations and the severe tension put on the tissues below by the scar contraction. Blood vessels can be seen through the scar epithelium.

has broken down repeatedly. About eighteen years before entry the upper eyelids began to be everted. She developed chronic irritation of the lids because of this.

On admission she showed extreme retraction and ectropion of the upper lids (fig. 13a) and was only able to close the eyes by lifting her lower lids above the pupils. The entire scalp was covered with multiple ulcerations between areas of thin scarred epithelium (fig. 13b). The photographs show the extreme retraction of the upper lids and of the skin in the region of the ear. Her other complaints were very few mild headaches and some photophobia at times, for which she wore dark glasses and applied ointments to the eyes She read with a magnifying lens, was obese, and had high blood pressure. The right ear which had been lost twenty-six years ago showed diminished hearing.

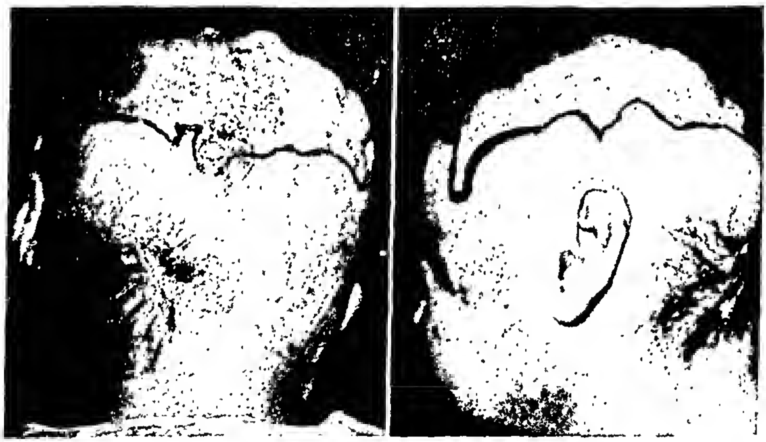
Biopsy did not show carcinoma in the ulcers and on conservative treatment these healed. At present the patient is free of ulcerations and has had operative work for partial correction of the deformities.

The return of sensation thirty-two years after the accident is shown in (fig. 14a, b, c, d). It is immediately apparent that the area above the dark line which is insensitive, has diminished vascularity, and is covered with thin scar epithelium would be likely to have frequent breakdown.

Case 5. P. S.–Age 7–No. 55415, New England Deaconess Hospital, Admitted: 8/7/30.

On August 7th, 1930, the fender of an automobile struck the patient who was dragged several yards. The scalp and right upper face were either completely avulsed or left hanging in shreds. The right parietal bone was exposed over a great area and the periosteum

a b



c d

FIG. 14. Four photographs showing how little sensation has returned in the thirty-two years following the accident. The extent of avulsion is also demonstrated.

had either been ripped or ground off over most of this region. The zygomatic process had been broken off and the top of the antrum removed. The external aspect of the orbit was broken through and the face was badly torn down to the corner of the mouth. The right ear was intact but was hanging as a flap. Multiple lacerations of the left arm and an epiphyseal fracture of the right humerus were also present.

a b

c d

FIG. 15. (a) Photograph showing the wound nineteen days after the injury. Case 5.
(b) Photograph demonstrating ectropia of both upper and lower lids.
(c) View showing tubed pedicle flap taken from back and swung upward to an attachment on the forehead.
(d) Photograph showing the next step in the plastic repair.

Fig. 15a shows the wound nineteen days post trauma.

Fig. 15b shows the ectropia of the upper and lower eyelids more than a year post trauma.

This defect was covered with a tubed pedical flap which was prepared from the scapular area while the wound was being cleaned up. The flap was attached to the region of the outer canthus where the globe of the eye was exposed (figs 15c and 15d). After the procedure shown in 15d, the patient unfortunately did not report for further treatment.

Case 6. C. C.–Age 56–Unit No. 363646, Massachusetts General Hospital, Admitted: 10/25/45.

FIG. 16. Photograph showing the scarred area in Case 6 and the carcinoma which had developed in it.

This patient has been taken care of by Dr Ernest Daland, who has kindly given us permission to use the photograph and her history in this article The patient in infancy lost a large portion of her scalp from abrasion and infection following the removal of a cradle cap. Since that time this region had received trauma at frequent intervals. Two years before entering she scraped her head on some rough plaster causing an ulcer which never healed. There was no pain associated with the lesion but the region around the ulcer was tender.

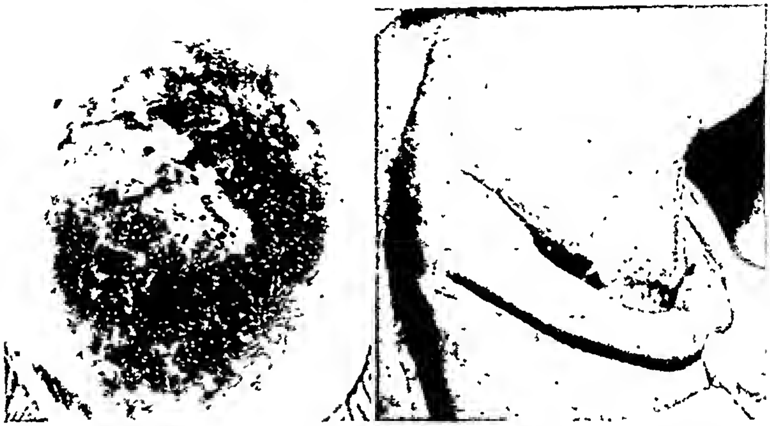
Examination on admission showed a 5 x 15 centimeter scarred area on the scalp. In the region of the vertex there was an ulcerating 4 x 5 centimeter new growth (fig 16). The ulceration extended through the skull to the dura, and pulsation could be seen in the center of the growth.

On 10/31/45 under intratracheal GOE anesthesia, the patient underwent an excision of a wide margin of skin and bone and of involved dura. The tumor also involved the superior longitudinal sinus. A fascia lata graft was applied to fill the dural defect and the patient was given 3000 r of X-ray to the area post-operatively.

The pathology report was epidermoid carcinoma.

Case 7. M. M.–Age 53–Unit No. 73672, Massachusetts General Hospital, Admitted: 5/25/45.

Twenty-five years before entry, the patient suffered a complete avulsion of a large part of her scalp by machinery. This healed by scar epithelium and by a few small grafts, type uncertain, from the thigh. Three years before entry, she noticed a small "mole" on the scalp. This increased in size and was finally excised by her local doctor. It recurred and was twice more excised, but recurred again and failed to heal. She was started on local applications, but the lesion increased in size. She was seen at another hospital where the first stage of a rope graft was carried out. The patient refused to finish the procedure, and left the hospital against advice. Local penicillin to the lesion had cleaned it up somewhat, but it never completely healed.



a b

FIG. 17. (a) Photograph showing the extent of the scarred area in Case 7, and the size of the ulcerated carcinomatous portion.
(b) View showing the large tubed pedicle flap running from the back to the right breast.
(c) Photograph showing the tubed pedicle attached to the forearm and applied to the scalp defect left after excision of the lesion.
(d),(e), (f). Three photographs showing the appearance of the patient at discharge.

Physical examination showed a very obese patient who possibly had hypothyroidism as the result of a thyroidectomy. Fig. 17a shows the appearance of the lesion and of the scarred area on the scalp. A biopsy of the lesion on the scalp was reported as papilloma and acute inflammation. X-rays of her skull showed an irregularity of the outer table in the midparietal area.

On 6/21/45, under GOE anesthesia, the patient had a large rope constructed with a pedicle in the middle of its length as well as at each end. The rope ran almost from the mid-line of the back, around the right side, to the lower part of the right breast. The culture from the ulcer showed abundant Staphylococcus aureus and a few non-hemolytic Streptococci.

On 7/7/45, under 1% novocaine anesthesia, the middle pedicle was separated and the edges sutured together (fig. 17b). This left a long rope running from the back to the base of the right breast.

c d

e f

Fig. 17 (continued)

On 7/18/45, under novocaine and gas oxygen anesthesia, further undercutting was carried out along the anterior part of the rope in order to lengthen it.

Following each operation, she was put on intramuscular penicillin. The patient, between certain of these procedures, was allowed to go home.

On 9/13/45, one-half of the posterior end of the tube was cut, undermined, and sutured back in place under local anesthesia.

On 9/22/45, under 1% novocaine anesthesia, the rest of the posterior attachment of the rope was severed from its base with a very generous portion of skin from the back included. It was sutured back in place. The distal two and one-half inches, including for the most part the surplus skin removed with the tube, eventually sloughed.

On 10/11/45, under intratracheal GOE anesthesia, the posterior attachment of the pedicle was severed, spread open somewhat, and attached to the volar and lateral aspects of the lower right forearm. The defect left on the back was covered with a dermatome graft from the right thigh.

The patient was discharged on 10/28/45, and was re-admitted on 11/30/45. A biopsy taken from the lesion on the scalp now showed "Epidermoid Carcinoma, Grade II." By this time, the lesion on the head was about 5 x 2 inches in size.

On 12/4/45, under 2% procaine anesthesia, one-half of the anterior attachment of the rope on the right chest was cut through and then sutured back in place.

On 12/15/45, under intratracheal GOE anesthesia, the abnormal skin and tumor at the vertex of the skull were removed. In addition, full-thickness excision of the bone under this area was carried out. There was no evidence of neoplastic invasion on the deep surface of the bone or on the underlying dura. The end of the rope beneath the breast was cut through and the defect sutured. The arm was then brought up to the patient's head and the tube opened and spread out to its full width of about four inches. It was sutured to the posterior and lateral edges of the scalp defect over the dura (fig. 17c). The arm was held in place by a plaster cast around the head and neck with an extension running along the outer aspect of the arm.

Operation: 1/15/46 Under local anesthesia: The rope graft was severed from its attachment to the wrist and the defect thus made closed with interrupted stitches.

Operation: 1/30/46 Under local anesthesia: The flap was trimmed down and sutured to the remaining open scalp edges.

2/6/46 Patient discharged (figs. 17d, 17e, 17f).

CONCLUSIONS

(1) Judging from our experience in the two freshly avulsed cases, in which the periosteum was relatively intact, immediate covering of the defect with dermatome grafts is the preferable form of treatment. Although the wounds at this time are contaminated, they are not infected. The initial blood loss may be considerable but replacement therapy allows almost immediate operation. In these two cases where the entire raw surfaces were not covered, infection and debilitation hindered to a certain extent the later grafting procedures.

(2) Experience of others as well as our own case 2 where the best of available antibiotic, chemotherapeutic, and supportive measures were used conclusively demonstrates that replacement of scalp is not successful. However, we think that by trimming away galea and fat from the undersurface, as was done in that portion of the reapplied scalp which did live in case 2, it may be possible to put the avulsed scalp back on the pericranium with success. Because of the arrangement of hair follicles in the superficial fascia, this procedure may prevent future growth of hair; but, if successful, it would obviate the large wounds created by skin grafting adequate to cover the entire scalp defect.

(3) Even after the entire scalp is covered with dermatome grafts, we find that the scar lines which form where the grafts join each other are apt to break

down easily. For this reason, the patients must be instructed to take the most meticulous care of their new scalps and to wear some protection under their transformations.

(4) Measurements made in cases 1, 2, and 4 show how slow is the return of sensation. Case IV demonstrates well that even after over twenty years, sensation return may be quite incomplete.

(5) Where periosteum is removed, the exposed cortical bone should be chiseled away until multiple small bleeding points are found in order to facilitate formation of granulations on which thick skin grafts can be applied.

(6) Unless early treatment is adequate and the defect is changed into a closed wound, the severe scar contraction which subsequently occurs produces terrible deformities of the eyelids and may thus cause damage to or loss of the eye.

(7) In those cases where marked scarring has occurred, the dense, avascular, insensitive cicatricial tissue may develop frequent ulcerations and eventually undergo malignant degeneration. In both case 6 and case 7 bone and in case 7 dura as well had to be excised in the removal of the malignancies.

(8) A very large tubed pedicle flap migrated to the head using the forearm as a carrier is very useful in the repair of the defect left after removal of the malignancy and the scar tissue.

BIBLIOGRAPHY

1. Broca: Montpellier méd., Feb. 20, 1879, p. 296 (cit. by Davis)
2. Christopher, F.: Minor Surgery, Philadelphia: W. B. Saunders Co., 1930, p. 153
3. Davis, J. S. and Kitlowski, E. A.: Regeneration of Nerves in Skin Grafts and Skin Flaps. Am. J. Surg. 24: 501–545, 1934
4. Davis, W. B.: The Value of Delayed Single Pedicle Skin Flaps in Plastic Repair of the Scalp. Surg., Gynec., & Obst., 1938, 66: 899–901.
5. Davison, T. C.: J. A. M. A.: 70: 1368, 1918
6. Guermonprez: Cit. by Parisot, Thèse de Paris, 1898
7. Keen: Annals of Surg., Vol. 45, May, 1907, p. 641 (cit. by Davis)
8. Philpot: Brit. Med. Jour., Feb. 18, 1871, p. 162 (cit. by Davis)
9. Sneve, H.: An Operation for Re-covering the Denuded Cranium. Med. News, Phila. 62: 239, 1893.
10. Wales: Cit. by Love, Brit. Med. Jour., Jan. 7, 1871, p. 26
11. Clinic of Dr. Halsted: John Hopkins Hosp., Surg. History No. 21299 (first reported by Davis in his series)
12. Coleman, E. P.: A Method of Repair of Scalp Defects. Illinois M. J. 49: 40–43, 1926
13. Mason and Lester: Annals of Surg., Nov., 1909, p. 815 (cit. by Davis)
14. New, G. B., Figi, F. A., and Haven, F. Z.: Replacement of Tissues of the Forehead and Scalp. Surg. Clin. North America, 14: 607, 1934
15. Archibald, E.: Amer. Practice Surg. V: 8, 1908
16. Cushing, H.: Keen's Surgery III 1908, p. 47–49
17. Haubold: J. A. M. A., April 27, 1907, p. 1429, Vol. 48
18. Schede: Beiträge z. klin. Chir, Supplement-Heft. Tubingen, Bd. 64, Sept., 1909, p. 61
19. Souberbielle: Cit. by Lavacherie, Bull. d. l'Academie de Méd., T. 7, 1842, p. 866
20. Rylander, C. M. and Kisner, W. H.: Avulsion of the Scalp—Case Report. Am. J. Surg. 58: 150–151, 1942
21. de Marchettis, P.: Observationum Medico-Chirurgicarum Rariorum Sylloge. Accesserunt Aliquot Observationes Auctoris Posthumae. Per D. Titiano Bortoli. 142 pp. Patavii, apud Cadorinum, 1675
22. Pirogoff: Dennis' System of Surgery, Vol. 2, 1895, p. 564
23. Haggard, W. D.: Skin Grafting for Complete Avulsion of the Scalp—Surg. Clin. North America, 10: 719, 1930
24. Robertson, James: Quoted by Felix Robertson, Phila. Medical and Physical Jour., 1806, p. 27–30
25. Davis, J. S.: Johns Hopkins Hosp. Rep., 16: 257–362, 1911
26. Sutliff: Occidental Med. Times, March, 1890, p. 129
27. Vauthier: Cited by Parisot, Thèse de Paris, 1898

28. CELSUS, A. C.: Medicine: In eight books. Translation of James Grieve. 468 pp. London: H. Renshaw, 1838
29. FABRICE D'AQUAPENDENTE: Oeuvres Chirurgicales. 936 pp. Paris: Jean Pocquet, 1658
30. LUTHER M. STRAYER: Augustin Belloste and the Treatment for Avulsion of the Scalp. New Eng. J. Med. 220: 901–905, 1939
31. WHEELER: (cit. by G. F. Mitchell) Skin Grafting-Medical Annual, 1926
32. LEJARS: Urgent Surgery, Vol. 1, 1910, p. 87
33. BELLOSTE, A.: Le Chirurgien d'Hôpital. 367 pp. Paris: Laurent d'Houry, 1696. pp. 87–94
34. NETOLITZKY: Wiener Med. Wchnschr., 1871, p. 819
35. BARTLETT: Am. J. Med. Sc., Oct., 1872, p. 573
36. ABBE: The Postgraduate, Vol. 7, Aug., 1897, p. 298
37. SOCIN: Cit. by Miyata, Archiv. f. klin. Chir., Bd. 85, 1908, p. 962
38. BALAS: Pest. med. chir. Presse, Budapest, No. 49, 1906, p. 1149
39. ROBINSON: S. G. & O., Vol. 7, Dec. 1908, p. 663
40. GOULD: Proc. Roy. Soc. Med. London, Vol. 3, No. 6, April 1910, p. 129
41. BANKS, A. G.: Avulsion of Scalp. Brit. M. J., 1928, Nov. 17, p. 893–894
42. KILNER, T. P.: in 2nd edit. of Ogilvie's Recent Advances in Surg. 1929. P. Blakiston's Son & Co., Phila.
43. NEW, G. B. AND ERICH, J. B.: Hairbearing scalp flap for the repair of unilateral scalp defects. Surg. Clin. North America, August, 1944, p. 741–750
44. CAHILL, J. A., JR. AND CAULFIELD, P. A.: Complete Avulsion of the Scalp and Loss of the Right Ear. S. G. & O., 66: 459–465, 1938
45. OTTO, THOMAS O.: Avulsion of the scalp treated without grafting. Ann. Surg., **102**: 315, 1935
46. MITCHELL, G. F.: Brit. M. J., I: 13–14, 1933
47. DOWNS: London Med. Gazette, Vol. 23, 1839, p. 907